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TUBERCULOSIS OF THE TONGUE

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THE purpose of this paper is not so much to review exhaustively the literature as it is to report a series of 15 cases of this comparatively rare manifestation of tuberculosis. The cases, all of them hitherto unreported, have been gathered from the records of the Johns Hopkins Hospital and Dispensary and the Union Memorial Hospital of Baltimore. Several of the series have come under the direct observation of the authors. Suffice it to say that the literature on the subject has been rather thoroughly studied and epitomized. Anyone wishing to go more deeply into the subject is referred to the very excellent bibliographies appended to the contributions of Delavan, von Ruck, Durante, and Handfield-Jones, which have been freely used by us.

The first reference to "tubercle of the tongue" was apparently made by Morgagni in 1761, but as his description is rather inconclusive, and as almost any sort of tumor at that time might be referred to as a "tubercle," one cannot be certain that tuberculosis was specifically meant. The first undoubted case was recorded by Portal in 1804, followed in order by Louis, 1825; Renaud, 1831; Fleming, 1850; Gildmeister, 1852; Paget, 1858; Wagner, 1862; Virchow, 1864, who was the first to report a case from autopsy. All of these cases were of the secondary variety, that is, there were tuberculous lesions demonstrable elsewhere in the body, chiefly in the lungs. The first primary case was put on record by Enteneur in 1872, followed by Clarke in 1876. The latter is one of the few cases in which the claim of a primary lesion was made good by a subsequent complete autopsy which revealed no other tuberculous lesions. In the same year, Nedopil reported four cases, three of which, however, will certainly not bear very close inspection of their claims to being primary. Gleitzman, in 1888, recorded the first case of a primary tongue lesion which was apparently cured by treatment, one of very few to be found in the literature.

On certain features of tuberculosis of the tongue, the conclusions of many contributors to the literature on the subject are in marked accord, on others there is equally marked discord. The opinions, therefore, expressed in this paper are based partly on reading, partly on analysis of cases, and partly on our own observations.

Tuberculosis of the tongue is quite rare, occurring principally in cases of advanced pulmonary tuberculosis, and is not infrequently associated also with laryngeal manifestations. There are very few cases of undoubted primary tuberculous lesion of the tongue on record. Considering the number of active tubercle bacilli which must come in contact with this organ during the life of any ordinary individual, and so much more so in the case of one suffering with pulmonary or laryngeal tuberculosis, this fact can be explained only

by the natural immunity which the buccal cavity seems to enjoy against many forms of virulent organisms. Whether this apparent immunity is due to almost constant motion of the organ, the character of the mucous integument, the normal secretions, or some other unexplained factor, it is impossible accurately to determine.

Tuberculosis of the tongue may be primary or secondary, the latter being by far the more common. To assert that there is no such thing as primary tuberculosis of the tongue, as some authors have done, is to make a far too sweeping statement. Just as it is frequently very difficult to decide whether a certain phenomenon is cause or effect, so it may be quite as impossible to tell whether a given lesion may be the primary focus or a secondary manifestation of the disease. If it is possible for a tuberculous ulcer to develop in a traumatized area of the tongue by implantation of some of the organisms present in the sputum, e. g., bacilli from an active pulmonary or laryngeal lesion, why may it not be possible for a laryngeal or pulmonary tuberculosis to develop from aspiration of organisms from an open lesion of the tongue? And in the absence of any demonstrable physical signs of tuberculosis elsewhere, why would one not be justified in pronouncing it a primary lesion of the tongue? We have, in our series, at least 4 cases which seem to have the right to be classed as such. The secondary cases are far more common, in fact, most of the reported cases have occurred quite late in a generalized tuberculosis, in some instances, as terminal manifestations. Our own records are quite in accord with this observation.

Tuberculosis of the tongue may manifest itself in several forms: (1) Lupus, either sclerotic or ulcerative. This form seems to occur only as a direct extension of a similar lesion from the face, cheeks or lips, and apparently has never been observed as an isolated lesion of the tongue. We have no cases in our series falling in this division. (2) Tuberculoma. Usually a single nodule, deep in the muscular substance of the tongue, commonly mistaken for a neoplasm or gumma until after excision. It may be of long duration, but, as a rule, tends to caseate, soften, form a cold abscess, and ulcerate. In this way it is often the antecedent of an ulcer, though it is rarely seen in its original state. There is at least one such in our series. (3) Cold abscess, referred to above as an intermediary stage between tuberculoma and ulcer. It is very uncommon to encounter it in the abscess stage, though such cases have been reported. We have none to add to this group. (4) Papilloma, an hypertrophic, proliferative type, giving a soft, vascular warty tumor; an uncommon form. One case in our series demonstrates this subdivision. (5) Fissure, a special form of ulcer, and one forming a large group. It manifests itself as a superficial crack, sometimes branching, which, when its edges are spread, reveals a surprising depth with a broad base frequently studded with tubercles or covered with caseous material. The lateral walls at times are quite indurated, even almost cartilaginous, but quickly shade into normal tongue tissue at a short distance from the crater. Possibly this is the immediate result of a tuberculoma rupturing on the surface before it has had time to spread and become a wide ulcer. This is rather questionable, however, since fissures, as such, may occasionally persist for a considerable period of time. We have two cases of fissure in our series. (6) Ulcer, the most frequently encountered tuberculous lesion of the tongue, usually rather shallow, with indefinite irregular, almost serpentine edges, which are not everted, not undermined, and as a rule are not indurated. The base is usually covered with grayish-white material penetrated in places by tufts of rather pale unhealthy looking granulation tissue. They may be single or multiple and show a marked tendency to heal and break down again, either wholly or in part. At times, on close inspection, small tubercles may be seen just beyond the edges of the ulcer; these tend to coalesce, break down, and thus advance the ulcer. The remainder of our cases fall in this group of ulcer proper.

The mode of establishment of the focus in the tongue would seem of necessity to fall into one of the following channels; direct attack upon normal tissue; implantation in traumatized areas; direct extension of pre-

Fig. 1. Tuberculosis of tongue. Low power photomicrograph showing giant cells.

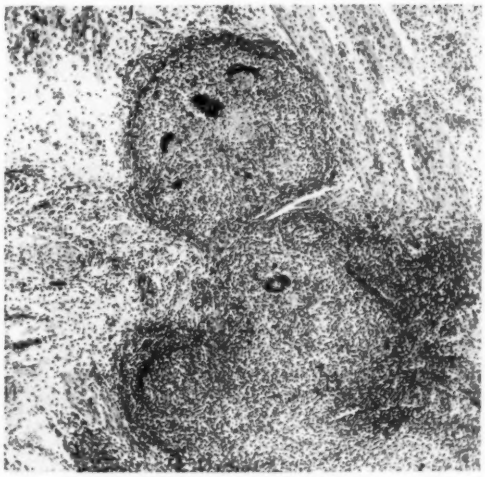

Fig. 2. Photomicrograph showing tubercles in tuberculosis of the tongue.

existent lesions; blood-borne embolus, or lymph-borne organisms. Theoretically any of these modes would appear to be possible, but practically the second and third would seem to be the most common.

The site of predilection is usually stated to be the tip or margin of the tongue. It would seem, however, that the dorsum, anterior to the circumvallate papillæ is equally as commonly attacked. Less often the lesions may be found far back on the base, on the inferior surface or on the frenum. We have in our list cases illustrative of every one of these locations.

We have been unable to demonstrate any constantly recurring predisposing condition or trauma, such as the association between leucoplakia buccalis and cancer, pipe stem and cancer, or positive Wassermann and cancer. In none of these cases has leucoplakia been a noted feature; none has had a positive Wassermann; one or two have been pipe smokers, but no relation could be demonstrated between the position where the pipe was habitually held and the site of development of the ulcer. Several of the patients had bad teeth with varying degrees of pyorrhœa alveolaris. Several sought to trace the formation of the lesion to one single cause, biting the tongue, rubbing of a broken tooth or plate, and in one instance, a shoemaker, to the trauma arising from the shoe-nails habitually held in his mouth. If, then, we leave out of account the presence of a pre-existing active laryngeal or pulmonary lesion as a predisposing factor, we are forced to the conclusion that trauma is the one important etiological factor.

One of the striking features in this series of cases is the absence of any great degree of pain in almost every instance. This is quite at variance with most of the opinions heretofore expressed. True, several of the patients complained of some discomfort, a "burning sensation" or a "soreness," most marked when eating highly seasoned or very hot food. In most instances, this was not of sufficient degree materially to alter the diet. The "excruciating suffering" so frequently referred to in the literature was conspicuous by its absence. There are, on the other hand, several cases in which even careful questioning failed to elicit any complaint of pain. It would appear, then, that pain is not a particularly prominent feature of the disease, and that, when present, and in marked degree, it occurs, as a rule, late in the disease. It is interesting to note that when pain becomes a prominent feature, there is usually associated with it a profuse salivation, which, heretofore, has not been marked.

Another point worthy of note in the figures of reported cases, and one on which practically all the authors agree, is the great preponderance of cases in males, in which respect tuberculosis of the tongue resembles carcinoma. Our statistics are in entire accord with this, there being but two women in the fifteen cases. An interesting fact is the complete absence of cases of tuberculosis of the tongue in the colored race both in our series and in the literature, particularly in view of the frequency of other types of tuberculous manifestations in this race.

There is a wide variation in the age of incidence, cases being reported in very early childhood, and one in an individual of 81 years, as the other extreme. Most of them, however, fall in the period between 30 and 60. Analysis of our cases shows two in the twenties, and one in the early sixties, the other twelve falling in the limits stated above, with the greatest number, seven, occurring in patients in the forties.

There appears to be no constant regional adenopathy in connection with tuberculous tongue lesions; the submental, submaxillary and cervical glands may or may not be enlarged. Certainly their presence or absence is no striking feature of the disease.

It is frequently quite difficult to obtain tubercle bacilli from scrapings of the lesion. Sometimes it is possible to demonstrate the organisms in properly stained tissue sections. Sometimes guinea-pig injection is of aid, but because of the multiplicity of pathogenic organisms constantly present in the mouth, this is usually useless. So, also, the microscopic picture is sometimes atypical and difficult of interpretation, notably in the frequent absence of giant cell formation, which is such a common feature of tubercle formation elsewhere.

The diagnosis of tuberculosis of the tongue is usually made by a process of elimination of the other possibilities, carcinoma, lues, benign or aphthous ulcer, and the more rare mycoses, etc. These are what might be termed negative aids, while the positive are the actual appearance and clinical characteristics of the lesion itself, the proving of an active tuberculous lesion elsewhere, the microscopic examination of material removed, for organisms or tubercle formation, and the inoculation of susceptible animals. The characteristic common to tuberculous lesions elsewhere in the body, namely, the tendency to temporary healing with subsequent reappearance, often repeated, may be of diagnostic value in this lesion.

So far as treatment is concerned, many and widely differing forms of therapy have been tried and advocated from time to time. These range from many kinds of local applications —iodoform powder, copper sulphate, silver nitrate, phenol, salvarsan paste, bismuth paste, violet ray, X-Ray, radium—through surgery —local cauterization, excision, with or without the regional glands, and total extirpation of the tongue—to general treatment with injections of salvarsan, tuberculin and various individually prepared "specifics." Except in a few instances, the results seem to be the same —temporary improvement with healing and relief, and a subsequent, usually prompt, recurrence of the trouble in spite of continued treatment.

The prognosis, therefore, seems uniformly bad, though there are a few cases reported which are apparent cures. The general infection, the fact that most tongue lesions are merely concomitants of an advanced pathology elsewhere, would naturally affect the result very materially and render it extremely difficult to consider the tongue lesion, per se, as a separate entity.

CASE REPORTS

We have fifteen cases to report, showing tuberculous disease of the tongue. Ten of these have been house patients in the Johns Hopkins or Union Memorial Hospital. The other five have been observed in the out-patient dispensary of the Johns Hopkins. They cover a period of somewhat over 21 years; several of the more recent cases have been under the personal observation of the authors.

CASE 1. Johns Hopkins Hospital, No. 14317. Mrs. H. K., age 48 years; housewife. Admitted January 29, 1903, discharged February 26, 1903. The family history is essentially negative except that one brother has a chronic cough, and several aunts and uncles died of consumption. Patient's general health has been good. Necrosis of the upper jaw followed removal of a tooth 20 months ago.

Fig. 3. Photomicrograph showing undermining at edge of the ulcer in tuberculosis of the tongue.

Fig. 4. Photograph of patient with tuberculosis of the tongue.

She had an ulcer on the roof of the mouth about 1½ years ago; this has gradually increased in size; is painful at times, but, as a rule, is painless. Patient is a rather poorly nourished, moderately anæmic woman. Examination of mouth shows in right upper jaw a small sinus which leads down to bare bone. On the left side of the roof of the mouth, opposite to and including gum around the last two molars, is an ulcerated area about 2 centimeters in diameter. Its edges do not seem everted and the base looks fairly clean, giving the impression of being rather superficial; edges do not feel indurated. On the tongue, just opposite the above ulcer, is a small, very slightly indurated spot about 7 or 8 millimeters in diameter, which is not ulcerated and looks somewhat like a collection of large tubercles. In the neck, a few enlarged glands are felt in both submaxillary regions. One gland on the left side has a suspiciously hard feeling. Tentative diagnosis: Carcinoma of the roof of the mouth. Operated upon by Dr. Halsted. Excision of the ulcer of the hard palate, nodule in the tongue, and glands of the neck. Pathological diagnosis by Dr. J. C. Bloodgood: Tuberculous ulcer of the hard palate and tongue with involvement of the glands. Patient made a good recovery, leaving the Hospital with the wound of the upper jaw still granulating. Later reports show no improvement.

Case 2. Union Memorial Hospital, No. 2821. Mr. H. U., age 40 years. Admitted September 20, 1904, died October 4, 1904. The family history is negative. Patient's general health is good. He has been a moderate user of alcohol and tobacco; no pipe, however. He had Neisser infection twice; denies lues. He has no chronic cough; slight expectoration, never blood-tinged; many night sweats during past 3 months. Patient had pain in tongue 2½ years ago, when a small ulcer was first discovered. At first, pain was slight, but it has steadily increased in intensity and is now almost constant and very severe. Patient has lost about 30 pounds. Patient is a very poorly nourished, sick, anæmic looking man, eyes sunken. He is not able to protrude the tongue far. About 3 centimeters from the tip, there are ulcers, covered with what look like small gray tubercles. The whole tongue, as far as could be examined, was inflamed, beefy-looking and indurated, as well as extremely painful to the touch. The ulcers have a slightly punched-out appearance around their ragged edges, with gray necrotic base. The submaxillary glands on both sides are enlarged. The thorax is barrel-shaped, of typical phthisical aspect, has marked evidence of extensive tuberculous involvement of lungs on both sides. Both sputum and scrapings from ulcer show tubercle bacilli. Patient went down rapidly, dying suddenly of pulmonary hæmorrhage. Pathological report, Dr. Bloodgood: tuberculosis.

Case 3. Johns Hopkins Hospital, No. 24823. Mr. P. C. T., age 61 years. Admitted October 13, 1909, discharged November 8, 1909. The family history is negative. Patient's health has been excellent until a few years ago. He has no chronic cough, hæmoptysis or night sweats. He has some dyspnœa and palpitation. He is a moderate user of alcohol and tobacco. Six months ago, patient noticed a shallow ulcer on the tip of the tongue. This was somewhat sensitive. It was cauterized with copper sulphate, and almost healed, but broke

out anew and became much larger and very sore. Patient has lost about 15 pounds, which he attributed to difficulty in eating, because of the pain. Patient is a well developed, well nourished elderly gentleman, with tongue coated, teeth dirty, general pyorrhœa. At the tip of the tongue, almost exactly in the midline, is a small ulcerated tumor about one-half inch in diameter. It is somewhat indurated; its surface is hard and glistening, and it is in large part healing or healed. Tissue of the tongue, at a slight distance from it, feels perfectly normal. No glands felt. The lungs are clear throughout. Impression: carcinoma of the tongue. Operation by Dr. Halsted: partial excision of the tongue, ligation of both lingual arteries. Anterior half of the tongue was excised with the cautery. Pathological report by Dr. J. C. Bloodgood: Tuberculosis. Subsequent history: No local recurrence, but after 14 months tuberculosis of spine developed.

CASE 4. Union Memorial Hospital, No. 8720. Mr. J. T. E., age 49 years; farmer. Admitted April 27, 1910, discharged May 14, 1910. The family history is negative. Patient uses no alcohol; tobacco moderately. He denies venereal infection.

Sore on tongue appeared 3 months ago and was treated with mouth-wash and local applications. Patient is a well nourished man, not anæmic. On the right side of the tongue near the tip, is an ulcerated area the size of a dime surrounded by hard, indurated tissue; there is a second similar elongated ulcer posterior to this on the right margin of the tongue. The glands on both sides are considerably enlarged and very hard. The thorax is well formed; the lungs are negative. Operation by Dr. Finney: excision of glands of neck; excision of right half of the tongue with cautery. Postoperative recovery was good.

CASE 5. Johns Hopkins Hospital, No. 33138. Mr. T. K., age 45 years. Admitted October 27, 1913, discharged November 19, 1913. The family history is essentially negative. Patient's general health is good. He has had chronic cough for several years; no night sweats. He had Neisser infection at 20; denies lues. He smokes a great deal, usually a pipe, which he holds on either side of his mouth. He is rather alcoholic. About 3 months ago, he noticed a little blister on his tongue. This broke and ulcerated, and has grown slowly but steadily larger. Since then, several ulcers have appeared. The ulcers are not painful and do not bother him in any way. Patient has lost about 30 pounds within the last 5 months. Examination shows a fairly well nourished man. On the tip of the tongue, there is an ulcer about 6 millimeters in diameter on the margin just to the right of the midline, confluent with a somewhat larger ulcer to the left of the midline. The ulcers have rather deep bases, are grayish-white in color and rather nodular in appearance. There is a more superficial ulcer on the left side of the tongue, about midway between the tip and the anterior pillar of the tonsil. There is still another about 2 centimeters long extending from about midway of the tongue to the posterior pillar on the dorsum of the tongue. They are painful on palpation. There is some induration in the edges of the ulcers, with quite a hard base. Very little surrounding induration of the normal tongue tissue. They do not bleed easily. The ulcers have rather ragged edges with serpentine projections. Cervical and submaxillary glands on left side slightly enlarged. There is evidence of rather extensive active tuberculous lesions in both apices, with probable cavitation on the left. Operation, Dr. Heuer. The anterior portion of the tongue, leaving a margin well back of the ulcers, was excised with the cautery. Two other ulcers along the left lateral margin of the tongue were similarly excised. Postoperative course was rapid and uneventful. During hospitalization tubercle bacilli were recovered from the sputum several times. Pathological report by Dr. Bloodgood, No. 14863: Sections show typical tuberculosis with giant-cell formation. They also show evidence of epithelial activity associated with the tuberculosis. Without the evidence of tuberculosis, one might, with considerable justification, look upon this as malignant. Multiple ulcers of the tongue are usually tuberculous or syphilitic patches, but we have observed, in a few cases on the tip, multiple ulcers due to cancer. In this case the induration about the ulcers was less than we have observed in cancer.

CASE 6. Johns Hopkins Hospital, No. 34809. Mr. H. C., age 45 years. Admitted June 19, 1914, discharged July 8, 1914. The family history and past history of patient are negative. About 18 months ago, patient noticed a sore on the left side of the tongue. He attributes the sore to irritation from a broken dental plate. Under local application of mouth-wash, the sore healed, but has broken down from time to time. He has slight pain on motion of the tongue. Patient is a well nourished, healthy looking man. On left lateral border of the tongue, about its middle, is a rather diffuse scar which causes flattening of this portion of the tongue. It is entirely healed and there is no induration of the tongue except directly in the scar, and this is very slight. On the floor of the mouth, adjacent to the scar, there is a small ulceration, soft, rather fungoid, bleeding slightly when touched. There is also a small ulcer on the dorsum of the tongue about 2 centimeters from the ulcer mentioned above. This is deep and excavated at its base, has a slight area of hyperæmia surrounding, no infiltration. A small gland is felt in the submaxillary triangle on this side. Operation by Dr. McClure: Resection of glands of neck, left side. Cauterization of ulcer of the tongue. Pathological report: tuberculous glands of the neck. Postoperative recovery was rapid and uneventful. Admission II. No. 35489. Admitted October 12, 1914, discharged November 2, 1914. Interval history: Since leaving the hospital, patient has had some pain in the mouth; however, only after highly seasoned or hot food. He has lost no weight. In the angle between the lateral border of the tongue and mucous membrane of the mouth, running over

the alveolar ridge, is an irregular ulcer, measuring about 1.5 centimeters anteroposteriorly, and 0.75 centimeter vertically. Margins are rather indistinct; edges flattened on top; slightly elevated on the tongue border. The base is grayish-white, somewhat irregular, with several elevations of practically the same color as the mucous membrane of the mouth elsewhere. No surrounding hyperæmia; very moderate induration around margins with insensible transition into normal tongue tissue. There is a second irregular ulcer on the outer border of the sublingual duct elevation, covered with thin exudate. Manipulation of the ulcers is slightly painful. There is no evidence of the ulcer which was formerly on the dorsum of the tongue, no palpable glands. Operation II. Cauterization of ulcer of tongue. Postoperative course rapid and uneventful. Admission III. No. 39161. Admitted January 5, 1916, discharged March 20, 1916. Interval history: About 3 months following discharge, patient had pain in the right side of the tongue, but no sore was noted. One month later he noticed pain on the left side of the tongue; he had pain first on one side, then on the other. An ulcer was first noticed in the middle of the tongue 4 to 5 months after discharge from hospital. This ulcer has grown steadily since first noticed. There is some pain, mostly in the right side, not constant, usually noticed only when irritated by food or talking. Patient is well nourished. The tongue is bound down on the left side by broad adhesions to the floor of the mouth, preventing its protruding, and drawing it somewhat toward the left. On the dorsum of the tongue is an irregularly outlined ulcer about the size of a half dollar, occupying the central portion of the tongue. The floor of this ulcer is covered with a white, granular discharge. The base of the ulcer is about 2 to 3 millimeters below the surface of the tongue, the edges rather precipitous and somewhat indurated. There is considerable salivation. At the middle of the submaxillary scar are two small sinuses from which pus may be expressed. The lungs are absolutely negative. The Wassermann is negative. Sputum examination is repeatedly negative for tubercle bacilli. Operation III—curettage and cauterization of the tuberculous sinus tract of neck. During hospitalization the ulcer of the tongue was repeatedly cauterized with silver nitrate stick. The ulcer showed some tendency to heal under this form of treatment. Patient was discharged with ulcer still about the size of a five-cent piece, with instructions to return to dispensary for treatment. Admission IV. Admitted June 14, 1916, discharged June 26, 1916. Interval history: Since leaving the hospital about 3 months ago, patient has been able to pursue his occupation, returning to dispensary several times a week for treatment. The sinus in the neck has continued to discharge and the ulcer on the tongue still persists. It has increased somewhat in size and has recently become much more tender and painful. Examination shows ulceration of same general nature and character as on previous admission; however, the ulcer is distinctly larger, extending almost back to the second row of circumvallate papillæ, and anteriorly to within 1.5 centimeters of the tip of the tongue. It involves chiefly the left side of the dorsum of the tongue, extending well across the midline. The entire ulceration is rather flat, edges not well outlined, not everted. The base of the ulcer shows small, grayish, translucent areas resembling tubercles. Examination of the neck shows a small sinus in the center of the old scar, discharging pus. No glands are palpable on the left; few small enlarged glands on the right. Operation IV—complete excision of the ulcer of the dorsum of the tongue with subsequent cauterization of the base of the excision to control bleeding. Postoperative course was uneventful and patient left hospital with the excised area granulating nicely. Motion of the tongue was still somewhat painful, and there was a considerable continuous ache on the right side of the tongue. (Returned to Dispensary for observation for a couple of months, when patient was lost sight of). Letter from a friend February 28, 1917, said that the patient had died several months previously, but no cause of death was given.

Case 7. Johns Hopkins Hospital, No. 35956. Mr. R. C., age 30 years. Admitted December 22, 1914, discharged December 30, 1914. One sister died of tuberculosis. Patient's general health has been good until 18 months ago. He had Neisser infection at 20; denies lues. He has had some palpitation and dyspnœa on exertion for several years. He has no chronic cough, no nightsweats. He uses tobacco in moderation. Patient is a poorly nourished young man, moderately anæmic. He has short cough at intervals. On the tip of the tongue, on the right side, is an ulcer about the size of a pea, with irregular margins, not elevated, everted or hard. The base of ulcer is pale, has little induration, and is covered with thin, grayish exudate. There is no special enlargement of the glands of the neck. There is marked active tuberculous involvement, consolidation and early cavitation of right apex of lungs; less marked involvement on the left. Operation by Dr. McClure. The ulcer was excised with a wide margin with the cautery; local anæsthesia. Pathological diagnosis by Dr. Bloodgood (Pathological No. 16733): typical tuberculous tissue.

Case 8. Union Memorial Hospital, No. 18707. Mr. C. C. H., age 37 years. Admitted October 26, 1917, discharged December 5, 1917. The family history is essentially negative. Patient's general health has been excellent. He has had night sweats every night for past few years; no hæmoptysis, no loss of weight, no chronic cough; appetite fair. He had Neisser infection at 24; no history of lues. He smokes considerably, mild cigarettes, and uses alcohol moderately. Patient admitted to hospital with a frank lobar pneumonia of the left upper and middle lobes; quite sick. A very slow recovery by lysis with everything eventually clearing up but an area about 2 inches in diameter near the angle of the left scapula. He had a slight cough, but practically

no sputum. No tubercle bacilli were found. His temperature every night was a little over 100. His general condition was good, he was gaining in weight. He felt perfectly well. He was discharged from the hospital with this patch still present, to remain in bed at home. Admission II. Admitted December 12, 1920, discharged December 16, 1920. Since the previous admission patient has never been in very good health. Following discharge he continued to have dry, hacking cough, shortness of breath, etc. On March 19, he had a moderate hæmorrhage from the lungs, and a rather extensive tuberculous involvement of both lungs was discovered. For about 6 months, the patient has noticed a small tumor in the midline on the frenum of the tongue and the floor of the mouth. This has grown very slowly; has never pained him or given any discomfort to warn him of its presence. Examination shows a moderately well nourished young man. Just beneath the tongue in the midline mostly on the floor of the mouth running up into the frenum of the tongue, is a small, hard, rather resilient tumor about the size of a peanut kernel. It seems quite superficial and fairly well encapsulated. The top is superficially ulcerated and its edges somewhat rolled in appearance. It does not interfere with the movement of the tongue; it does not bleed easily. There are no glands palpable. Examination of the lungs shows an area just beneath the angle of the scapula on the left which is quite dull to percussion, distant breath sounds, somewhat tubular in character. This area corresponds exactly with the area of unresolved pneumonia with which he was discharged on previous admission. Impression: Epithelioma. Operation, Dr. Stone. The tumor was excised with the cautery, with a wide margin. Recovery was rapid and uneventful. Pathological diagnosis: tuberculosis of the tongue and of the floor of the mouth.

CASE 9. Johns Hopkins Hospital, No. 50120. Mr. F. S., age 51 years. Admitted January 23, 1920, discharged February 5, 1920. The family history was negative. Patient's general health has been fair. He denies venereal infection. He does not use tobacco. About 3 months ago, while plying his trade of shoemaker, patient noticed that on putting the tacks in his mouth, as was his custom, the tongue was slightly sore, and that a small blister appeared just about the point where the nails had always rubbed against the tongue. A week later, by accident, the patient stuck one of the tacks into the sore place. It bled considerably and the tongue was quite sore for a couple of days. About a week later, the patient severely bit the tongue again in the same place. Since then the tongue has been pretty constantly sore, though with occasional complete remissions. Two weeks after biting the tongue, patient noticed that the area around and particularly behind the sore place was hard, and this hardness has persisted, though he thinks it varies in extent at times. The tongue has finally become so sore that he is unable to eat any hard or any very hot food. Examination shows a rather under-nourished man. On the left anterior half of the tongue, two-thirds of the way to the lateral margin, is an ulcer, rather ragged in outline, about 10 by 3 by 2 millimeters; it has a rather whitish opaque border, which when scraped, proves to be an easily removed white coating. The ulcer has an indurated base, rather diffuse and ill defined, but not extending quite to the midline. There is rather marked enlargement of the cervical, submaxillary, and submental glands, on the left side particularly. Examination of chest shows impairment over both apices, particularly over the right, with signs of active tuberculous involvement. The Wassermann is negative. X-ray of chest shows tuberculosis of both uppers, particularly the right, with probable cavitation. Operation by Dr. Dandy was done under light chloroform anæsthesia, because of the lung condition. The left anterior half of the tongue was excised. Pathological report by Dr. Bloodgood: advanced tuberculous infiltration and ulceration. Patient made a rapid and uneventful recovery, with very little pain, and was sent to State Sanatorium.

CASE 10. Union Memorial Hospital, No. 24871. Mr. J. B. E., Jr., age 36 years. Admitted February 9, 1922, discharged February 16, 1922. No complete history was obtained as patient had been sent from the State Tuberculosis Sanatorium for cauterization of the ulcer of the tongue. He has at present a very active pulmonary lesion. Examination showed a very extensive tuberculosis of both uppers with consolidation and probable cavitation. There is an ulcer on the posterior third of the tongue in the form of a deep fissure with rather hard, indurated edges, the induration extending about 1 centimeter beyond the edges where it fades into normal tongue tissue. The fissure itself has a gray, bloodless surface; it is quite deep and on retraction of the margins shows considerable undermining of its edges with rather caseous appearing necrotic base. There is no particular pain save upon manipulation. There is very little cervical glandular enlargement. Operation, Dr. Follis. The ulcer was excised with cautery under local anæsthesia, a fair margin being given. Postoperative course was rapid and uneventful, with very little pain. Patient was discharged to return to the Sanatorium.

DISPENSARY CASES

CASE 11. Johns Hopkins Hospital, No. G22777. Mrs. S. R., age 24 years. Admitted November 28, 1919, discharged December 17, 1919. Patient is an orphan, raised in an asylum from 7 to 15 years, and knows nothing of family. Her general health is good. She felt perfectly well until spring of 1919, when she began to cough, but after receiving treatment this gradually ceased and did not return. A sore throat was first noticed a month or 2 ago. Examination shows a rather thin woman. Peritonsillar tissues, pharynx and base of tongue are extensively ulcerated, with gray-white membrane. The epiglottis is thickened, cords move normally, but are markedly congested. The chest is well formed; evidence of

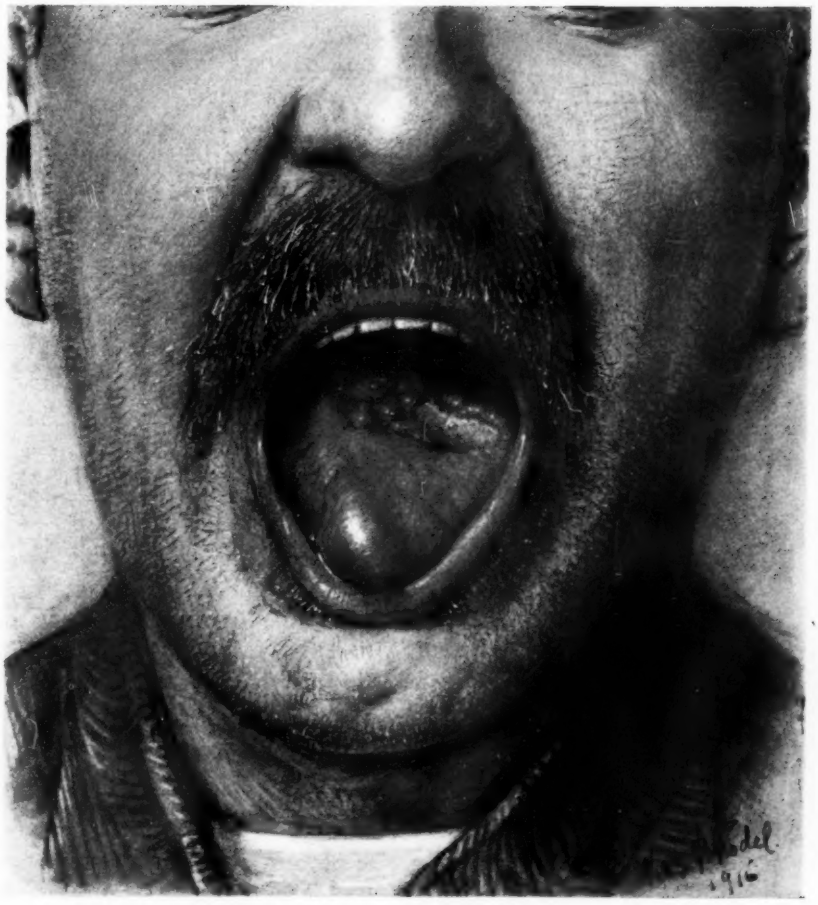

Fig. 5. Tuberculous ulceration of tongue.

Tuberculosis of the Tongue.—J. M. T. Finney and J. M. T. Finney, Jr.

active tuberculosis over right apex. X-ray shows miliary tuberculosis of both lungs. Wassermann is negative. Sputum examination is negative for tubercle bacilli. The ulcers were treated daily in dispensary with salvarsan paste; improved markedly so that pain on swallowing disappeared and patient could comfortably take a general diet, where even liquids before were almost impossible. Sent to Sanatorium.

CASE 12. Johns Hopkins Hospital, No. G24949, Mr. B. R., age 27 years. Admitted January 22, 1920, discharged January 26, 1920. Family history is negative. Patient's general health is excellent; no venereal infection. Onset of illness began 16 months ago, with cracks in tongue, followed in a few weeks by swelling under the tongue which soon ulcerated. This healed slowly under local treatment. At that time, patient was in the army in France. Four months later, ulcer reappeared on the tongue; was given eight injections of salvarsan, though the Wassermann was constantly negative. No improvement. For the past 12 months, patient has had local treatment of various sorts, but condition has gradually progressed. About 8 months ago, an ulcer appeared on the left side of the pharynx. He had very little pain except after eating acids or hot foods. He has had slight cough for past few months; has lost 25 pounds in weight. He was at the Government tuberculosis hospital for several months. He feels perfectly well, no night sweats or hæmoptysis. Examination shows a well built man, but thin and anæmic. The tip of the tongue is eroded by an ulceration, the base of which is grayish-white; edges somewhat thickened, not undermined. Ulceration feels somewhat indurated. The base has several reddish lumps of granulation-tissue extending above the gray base. The ulcer is about the size of a nickel. The margins of the tongue on both sides are thickened and show a couple of small ulcers. The glands beneath the angle of the jaw and the submaxillaries are slightly enlarged. Examination of chest shows marked tuberculous involvement of both lungs with probable cavitation about the right apex. The Wassermann is negative. X-ray of chest shows consolidation with cavitation of the right upper; soft spotty infiltration of the remainder of the right lung, and all over the left the changes are tuberculous in origin and almost miliary in character. Scrapings from the tongue show typical tubercle formation with several giant cells. Patient turned over to Public Health Service for sanatorium treatment.

CASE 13. Johns Hopkins Hospital, No. G84336. Mr. J. T. M., age 42 years. Admitted June 25, 1923, discharged July 2, 1923. One sister, one aunt, two uncles died of tuberculosis. Patient's health has been fairly good. He denies venereal infection. Has no chronic cough, hæmoptysis or loss of weight. For about 3 months, voice has been a little husky at times. About 5 years ago, patient noticed a slight soreness at the tip of the tongue, felt as though it had been burned. Within a few days, the soreness became more marked and a crack appeared at the tip. This healed in about 3 weeks. Ever since then there has been a periodic reappearance of a similar condition lasting from 2 to 5 weeks at a time, with intervals of freedom, as long as 6 months. At present, the lesion is about 6 weeks old. It causes some pain when patient eats or talks much. Examination shows a well nourished man with no pallor. Speech is a little thick; the tongue not enlarged. At the tip, in the midline, is a transverse fissure with gray-white, almost cartilaginous edges. The base of the ulcer is comparatively clean; no salivation. Submentals are just palpable; no glandular enlargement. The lungs seem clear. The Wassermann is negative. A wedge-shaped piece containing the ulcer was removed from the tip of the tongue, under local anæsthesia. Postoperative course was uninterrupted. Pathological report: No. 33347. The character of the tissue strongly suggests a tuberculous condition, but no typical tubercles are seen.

CASE 14. Johns Hopkins Hospital, No. H1488. Mr. C. W., age 54 years. Admitted May 12, 1924, discharged May 20, 1924. The father and two brothers died of tuberculosis; one sister died of cancer. Patient's general health is fair; no serious illnesses; has been subject to asthmatic seizures with chronic cough for about 32 years. No hæmoptysis; has been addicted to the use of morphia for relief of asthmatic trouble for a similar period of time; is now taking 3 to 4 grains daily, hypodermically. About 11 months ago, patient bit his tongue, which got quite sore. He had had a tooth pulled about the time of biting his tongue, and an abscess appeared at the site of the extraction. This was opened and has never healed. About 5 months ago, the tongue was examined by a doctor who diagnosed cancer of the tongue and advised radium treatment, which was given—a total of nine applications during the past 5 months. Tongue has constantly been somewhat sore with occasional burning sensation, but no great pain. Examination reveals a tall, emaciated, rather anæmic man. He has a discharging sinus with unhealthy looking granulations just behind the left lower canine tooth, bone is not exposed. The tongue shows superficial ulceration about 1 centimeter in diameter just beneath its tip in the midline. Ulcer has a grayish base, a trifle raised, fairly regular. The area around the ulcer is a little more firm than normal. Larynx and mucous membrane congested and infiltrated. Right false and true cords are both red and somewhat thickened. Left false cord is much infiltrated, somewhat irregular and obstructs the view of left true cord. No definite ulcerations are made out. No cervical glands are palpable. Evidence of tuberculous involvement of both apices, probably active, with scattered squeaks on expiration. Rectal examination showed an internal tuberculous fistula *in ano*. The Wassermann was negative. X-ray of chest shows tuberculous consolidation of both uppers, probable cavitation. Sputum examination reveals many tubercle bacilli. He was advised to enter sanatorium.

CASES OF TUBERCULOSIS OF THE TONGUE FROM JOHNS HOPKINS HOSPITAL AND DISPENSARY AND THE UNION MEMORIAL HOSPITAL, BALTIMORE

No.	Initials	Age	Sex	Occupation	Primary or Secondary	Lesion	Duration	Simple or Multiple	Location	Adenopathy	Treatment	Remarks
1	H.K.	48	F	Housewife	Secondary	Tuberculoma	1 mo.	Simp.	Dorsum, post.	Moderate	Excision, with glands of neck	Direct implantation.
2	H.U.	40	M		Secondary	Ulcer	2½ yr.	Mult.	Tip and margin	Moderate	Phenol	Died in hosp., pulmonary hæmorrhage.
3	P.C.T.	61	M	Watchman	Primary	Ulcer	5 mo.	Simp.	Tip, midline	None	$CuSO_4$; excision ant. ½ tongue	Preop. diagnosis—carcinoma.
4	J.T.E.	49	M	Farmer	Primary	Ulcer	3 mo.	Mult.	Margin, rt., near tip	Marked	Excision with cautery; ligation lingual art.; resection glands neck, rt.	Preop. diagnosis—carcinoma. Induration of lesion very marked.
5	T.K.	45	M	Laborer	Secondary	Ulcer	3 mo.	Mult.	Tip and margin left and dorsum	Slight	Excision with cautery	Marked epithelial proliferation at edge of ulcer.
6	H.C.	45	M	Peddler	Primary	Ulcer, papilloma	1½ yr.	Mult.	Margins, dorsum	Slight	Cauterization, excision with glands	4 admissions over 2 yrs. never any other tuberculous focus.
7	R.C.	30	M	Reporter	Secondary	Ulcer	2 mo.	Simp.	Tip, lateral	None	Excision with cautery	Sanatorium case.
8	C.C.H.	37	M	Army off.	Secondary	Tuberculoma just ulcerating	6 mo.	Simp.	Frenum and floor of mouth	None	Excision with cautery	Preop. diagnosis—carcinoma.
9	F. S.	51	M	Shoemaker	Secondary	Ulcer	3 mo.	Mult.	Dorsum and margin, anterior	Marked	Excision ant. left ½ tongue	Sent to Sanatorium.
10	J.B.E.	36	M		Secondary	Fissure	Several mo.	Simp.	Dorsum, far posterior	Very slight	Excision with cautery	Sanatorium case.
11	S.R.	24	F	Housewife	Secondary	Ulcer	7 wk.	Mult.	Dorsum, far posterior	Moderate	Salvarsan paste	Pain prominent. Sent to sanatorium.
12	B.R.	27	M	Farmer	Secondary	Ulcer	16 mo.	Mult.	Tip and margins	Slight	Salvarsan, intravenous; previous	Sent to sanatorium.
13	J.T.M.	42	M	Clerk	Primary	Fissure	5 yr.	Simp.	Tip	None	Excision	
14	C.W.	54	M		Secondary	Ulcer	11 mo.	Simp.	Beneath tip, midline	None	Radium, previous	Sent to sanatorium.
15	F.B.	36	M	Laborer	Primary?	Ulcer	Several mo.	Simp.	Dorsum, anterior	Moderate	Salvarsan intravenous	Operation refused.

CASE 15. Johns Hopkins Hospital, G 17300. Mr. F. B., aged 36 years; laborer. The family history is essentially negative. Patient's general health has been excellent; he has had no serious illnesses, no suggestive evidence of pulmonary tuberculosis. Primary sore about 10 years ago for which he had treatment, local and general, for a very short period. About 6 months ago he noticed a small sore on the middle of dorsum of tongue. The ulcerated area has gradually extended to the right side of the tongue, original area healing as extension occurred. It is not painful. Local treatment is ineffectual. On physical examination we find on the middle of the dorsum of the tongue a healed fissure; on the right side a slightly elevated area covered with yellowish exudate; surrounding area, smooth, red with small amount of granulation-tissue formation. A moderate bilateral glandular enlargement is present. Examination of chest gives practically negative result except for a slight impairment at right apex. No physical signs of lues. X-ray of chest is negative. Sputum examination is negative for tuberculosis. Wassermann, "suggestive negative." Patient was examined at the Phipps Tuberculosis Clinic, where impression was that patient had a tuberculous ulcer. He was treated for some time in Department L (lues) with intravenous injections of diarsenol, with no result.

Clinically, the case was quite definitely that of tuberculous ulcer of the tongue. Excision was recommended, but the patient declined any form of operation, and disappeared; diagnosis cannot, therefore, be confirmed by microscopic examination of tissue, but there can be little doubt clinically as to the nature of the trouble.

SUMMARY

In analyzing these case reports, there are certain points which would seem to bear

special emphasis. Of the 15 cases, 5 appear to merit classification as primary lesions—a very large percentage, we realize. On the other hand, if careful physical examination reveals no suspicion of an active tuberculosis elsewhere, are we not justified in this assumption, even though the claim cannot be supported by a subsequent autopsy—because none was obtained?

Three of the fifteen cases were operated upon on the assumption that they were carcinoma. In two of these cases, the lack of induration in the lesion was noted in the examination, but its significance was not then realized. In one instance, and that the only one in the series in which a stony hardness of the ulcer and the glands existed, the mistake would appear to be entirely justifiable.

In four cases, the tongue lesion was the means of bringing the patient to a doctor, and thus led to the discovery of a most extensive tuberculosis previously unsuspected. In four cases, the disease manifested itself either during or following treatment in a sanatorium for tuberculosis.

There are only two cases in women, in contrast to thirteen in men. Direct trauma seems to be the only important causative factor in any of these cases. In no case was the trauma to be charged to that popular bugbear, the pipe-stem.

Pain is not a prominent feature in this list of cases. In only one instance, and that a most fulminating case of only 7 weeks' duration, immediately following childbirth, was pain of the excruciating character usually described encountered. In two other cases, the pain might be termed severe, while in the remainder it was almost totally lacking.

The majority of the patients were in the forties; it might, therefore, be classed as another of the "afflictions of middle life." There is no site of predilection for the development of the lesion; any portion of the tongue may be attacked, with most of the lesions occurring anterior to the circumvallate papillæ, and about equally divided between tip, margins and dorsum. The tongue lesions may be single or multiple—our cases are about equally divided. There may or may not be any regional adenopathy; in none of these cases was glandular enlargement very marked, and in several it was entirely absent.

We have no special form of treatment to advocate. It would seem wise, however, in a case which seems to be primary, to treat it by wide excision, much as if it were carcinoma. We cannot discuss prognosis, even in the case of primary lesions, radically treated, as for lack of time we have not attempted to follow-up all of these cases.

The purpose of this paper is primarily to put on record the fifteen cases reported, and for that reason we have not discussed the literature at length.

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Fig. 2. The pyloric artery and the right gastro-epiploic artery have been ligated and cut. The duodenum denuded of its vessels and ganglia has been cut between two clamps. The clamp adhering to the stomach has been covered with the protector. Above and on the left, the duodenum is about to be invaginated. The two sutures which will insure the closing of the duodenum have already been placed. Above and on the right the burying is terminated. A continuous suture of safety is carried over the first closing.

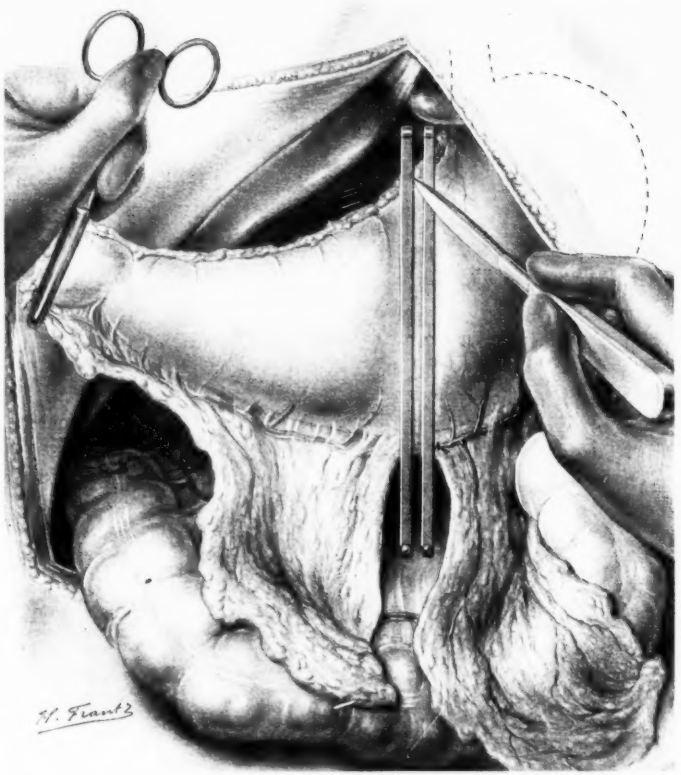

Fig. 3. The three-branch elastic clamp has been placed. The stomach is cut along the distal clamp. The middle branch of the clamp has been removed. A band of gastric tissue juts out beyond the gastric clamp; on section, it is easy to suture separately the two planes, mucous and seromuscular. Both sutures, one above the other, are hidden under a seroserous suture. The vessels of the lesser curvature are ligated at the level of this curvature at the spot where section of the stomach will be done. The same technique is followed along the greater curvature.

Remarks on the Technique of Gastrectomy.—T. DeMartel.

REMARKS ON THE TECHNIQUE OF GASTRECTOMY

BY T. DEMARTEL, M.D., F.A.C.S. (HON.), PARIS, FRANCE

I HAVE devoted the last 10 years almost exclusively to gastric and intestinal surgery, faithful to the principle that to perform well or, if need be, to perfect the technique an operation should be done in many cases. I have made postmortem examinations of all patients who have died following operation, and in this way I have been able to arrive at definite conclusions as to certain points which I will bring out briefly in this article.

PREPARATION OF THE PATIENT

I need not emphasize that a patient who is about to undergo a gastrectomy should be prepared for operation with the greatest care. Every precaution should be taken to lessen the septic action of the gastric contents; the mouth and teeth should be carefully cleansed; the stomach should be washed with antiseptic solutions—iodine solutions especially have been found very useful. The precautions named have become classical.

In the presence of gastric cancer, there often exists a large, infected, ulcerating area that no washings can render harmless. Sometimes this ulceration is found even in association with simple ulcer of the stomach. In such cases I wash out the stomach and make cultures from the liquid from such lavage. By means of these cultures I prepare serum and vaccine which I use in treating the case.

Just before beginning an operation on the stomach I inject 20 cubic centimeters of antipneumococcic serum. In a severe cancer case, I inject also 10 cubic centimeters of serum anti-œdematiens, 20 cubic centimeters each of antiperfringens and antivibrionseptique, and 10 cubic centimeters of antihistolyticus. This is done at the beginning of the operation while the patient is asleep.

ANÆSTHESIA

In doing an operation on the stomach I always use ether anæsthesia preceded by a hypodermic injection of 1 centigram of morphine hydrochloride and a quarter of a milligram of scopolamine. The ether is given by means of an Ombredanne apparatus. By its drying quality, the scopolamine stops the excess salivation caused by ether, and thus renders anæsthesia easier. I have found no appreciable difference as far as pulmonary complications are concerned in the use of spinal anæsthesia.

POSITION OF THE PATIENT

The patient is placed as for an operation on the bile ducts; the upper part of the body is horizontal, the lower limbs, the middle part, and lower trunk are steeply inclined. In this position all of the small intestine falls to the lower part of the abdomen and the subdiaphragmatic region is as freely accessible as possible.

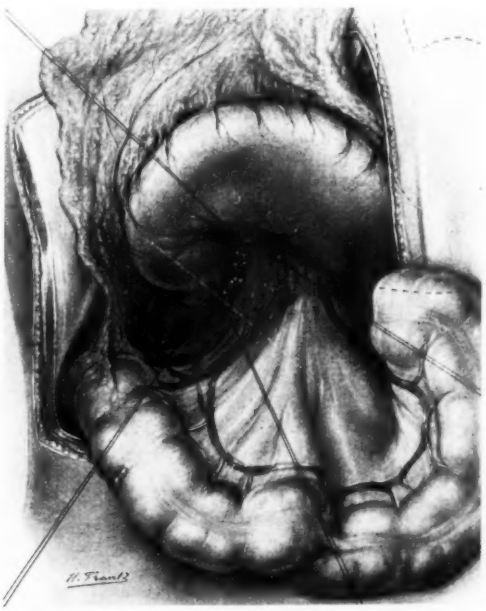

Fig. 1. The gastrocolic omentum has been freed. The pyloric artery, the duodenopancreatic artery and the right gastrocolic artery have been ligated. Notice the ganglia. Once the arteries have been cut, the ganglia are removed by stripping the duodenum with a compress.

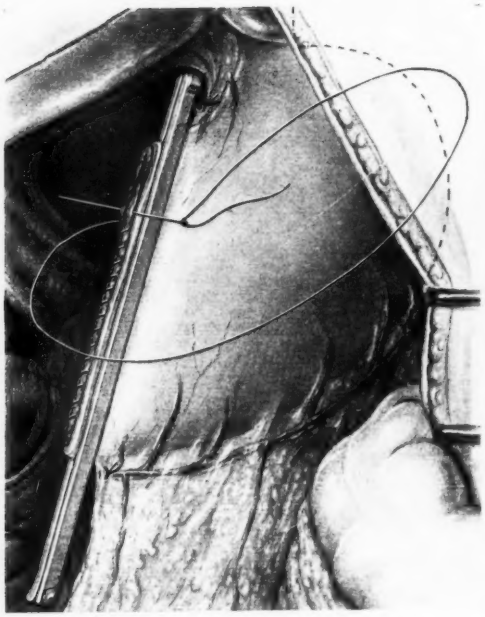

Fig. 4. The mucous membrane is drawn together by a fine continuous suture along the proximal clamp.

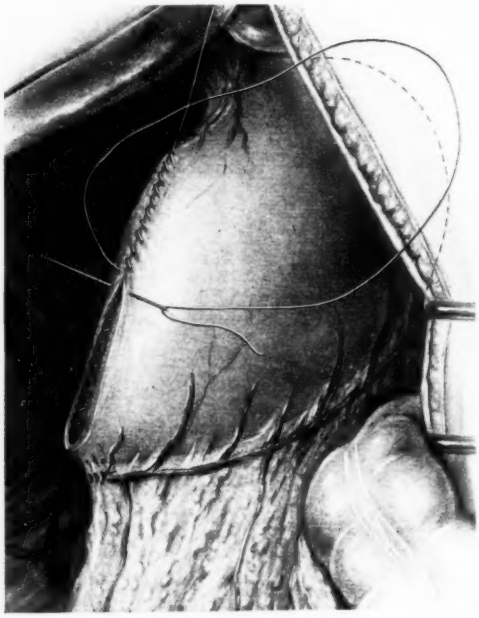

Fig. 5. With a similar suture one unites the musculoserous layer.

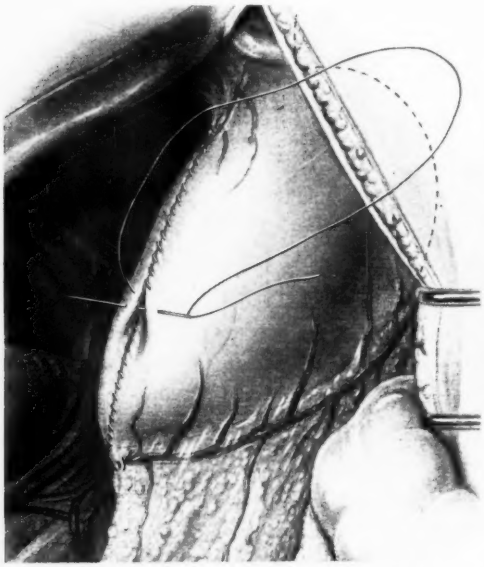

Fig. 6. In this way the stomach is closed by a two-layer suture which in its turn is covered over with a seroserous continuous suture. After a few hours the mucous membrane suture gives way, being cut by the thread. Two sutures alone remain, the seroserous, with no septic tissue enclosed.

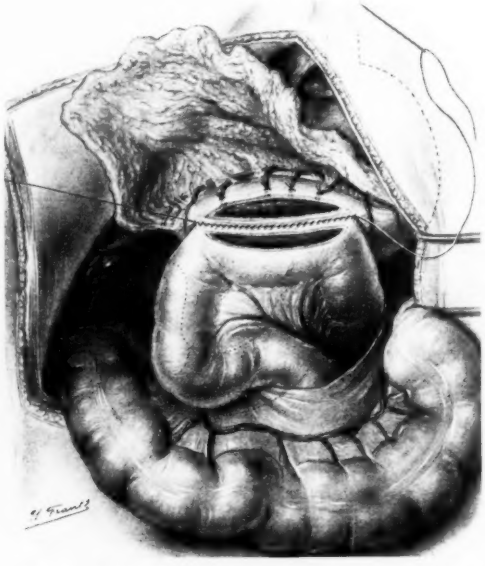

Fig. 7. The stomach and the intestine are united by a seroserous suture close to the great curvature. The vessels of the great curvature have been ligated one by one to prevent excessive hæmorrhage when the stomach is opened. The seromuscular layer of the stomach and intestine alone has been cut.

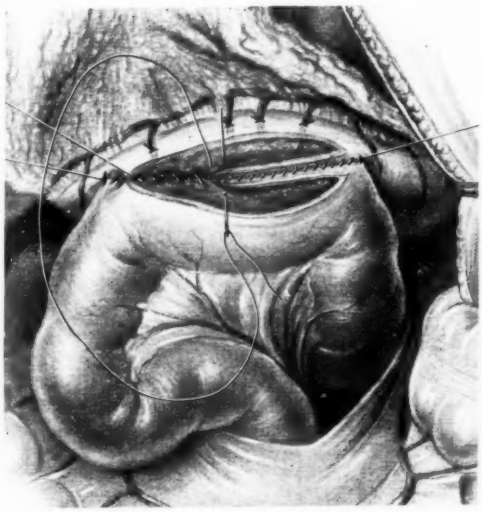

Fig. 8. A perforating suture unites the intestine to the stomach but the mucous membrane of both organs is still intact.

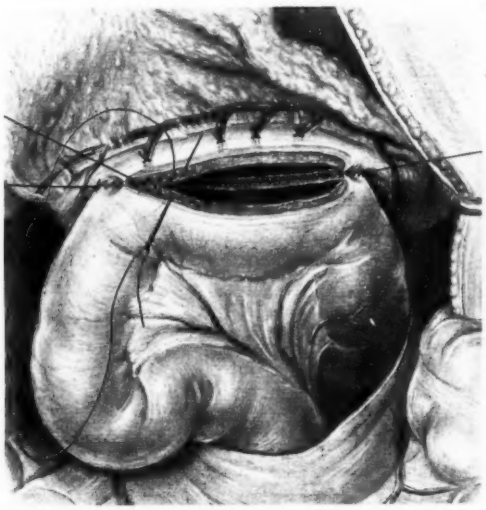

Fig. 9. The stomach and intestine are open. A mucomucous suture closes both viscera. Over this another suture unites musculoserous to the musculoserous.

INCISION

The median supra-umbilical incision should be long, and if necessary should extend both above and below the umbilicus. If necessary a transverse incision may be made across the rectus abdominis muscle which can easily be repaired by successive sutures of the two layers of the sheath of the muscle. More often the rectus abdominis is cut on the right side so as to expose the pylorus clearly, as the pylorus is often affected by lesions and often deeply placed. Sometimes in lesions of the lesser curvature near the cardia the left rectus

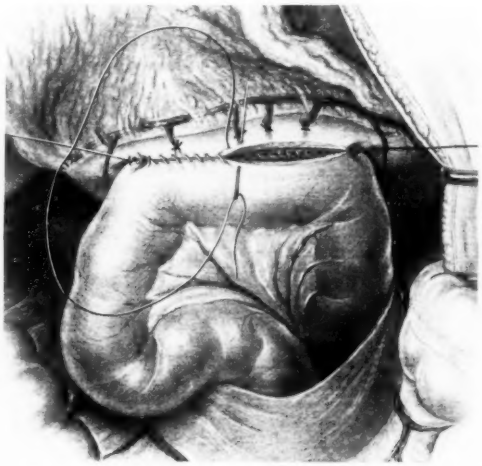

Fig. 10. Suture of the seromuscular layer above the mucomucous layer.

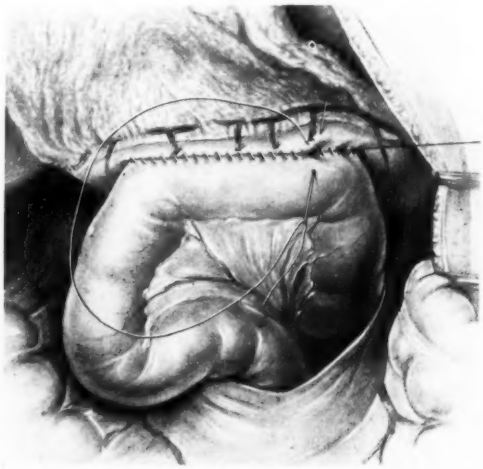

Fig. 11. A seroserous suture is carried above the two-layer suture, mucomucous and seromuscular. The mouth of the gastro-enterostomy is very near the greater curvature.

Fig. 12. The stomach drawn out of the abdomen is turned over on the left edge of the incision. A seroserous suture unites the jejunum to the stomach. The small intestine is led along the stomach passing in front of the great intestine. The intestinal mucous membrane has not been touched. The gastric mucous membrane is open in only one spot where the aspirator cannula enters the stomach. It remains only to incise the stomach and intestine and to finish the gastro-enterostomy as described in the papers mentioned.

abdominis must be cut at some distance from the ribs to give proper space. Sometimes both incisions may be combined, so as thoroughly to expose the entire stomach. It is absolutely necessary to operate without forcing or straining. Rough handling causes many phenomena such as shock and perhaps also infection, which is provoked by the infection-bearing lymph entering the general circulation. It is for these reasons that I have abandoned the crushing method in cancer operations.

EXPLORATION

First, the anterior surface of the stomach is explored, then the pylorus and the lesser curvature. The lesion is nearly always found during this step. Adhesions to the liver and gall bladder are noted and their extent, and also the presence of ganglia along the greater curvature of the stomach. The gastrocolic omentum is freed, beginning on the left side (Fig. 1). When this detachment is completed the relation between the posterior surface of the lesion and the anterior surface of the pancreas and between the lesion and the superior surface of the transverse mesocolon may be studied. The last is most important. It is useless to undertake the ablation of a tumor if by so doing the large vessels of the intestine are injured and its vitality seriously compromised. After the greater omentum is detached the stomach is raised (Fig. 1). Then can be seen the head of the pancreas and the upper mesocolic portion of the second part of the duodenum, the large duodenopancreatic vessels, the right gastro-epiploic artery and the pyloric artery. The vessels are ligated as close as possible to the head of the pancreas (Fig. 1), by means of a suture passed between the vascular pedicle (arteries and veins) and the edge of the duodenum, in contact with the head of the pancreas. The suture is tied and the ves-

sels cut between the thread and a clamp. With a compress the vessels are drawn out and detached together with the ganglia which accompany them. The duodenum thus entirely stripped appears like a thick ribbon.

Two strong Kocher clamps are placed on the duodenum at a distance of a few millimeters from one another. The duodenum is cut as close as possible to the clamp which will remain attached to the part of the stomach to be sacrificed, the clamp nearer to the pylorus. This clamp is immediately covered with a protector (Fig. 2) which completely hides the section of the intestine and prevents the clamp opening. Two sutures, one white the other black to avoid any confusion, are passed through the thickness of the duodenal walls as close as possible to the head of the pancreas (Fig. 2).

The duodenum is invaginated and the two sutures are tied. This method of closure will prevent the formation of any closed septic cavity[1] and is superior to any other. It does away with all accidents arising from duodenal stumps, stumps necessarily deprived of a blood supply if the ganglia were thoroughly detached. A seroserous continuous suture is placed over the first line of suture (Fig. 2).

The stomach is drawn out of the abdomen. The vessels of the lesser curvature are ligated at the exact spot where the stomach will be sectioned, then they are cut. The same procedure is carried out on the greater curvature. One must avoid the excessive denuding of vessels on the outer parts of the stomach.

It is difficult to obtain ischæmia of the stomach, however clumsy and inexperienced one may be; nevertheless it is always to be feared. As I reported in 1921[2] it is possible to obtain with the diaphanoscope a perfect view of the badly irrigated portions of the stomach and intestine. With this instrument I have been able to discover that in very oblique sections of the stomach when preceded by ligation of the coronary artery and extensive denuding of the greater curvature, the head of the gastric stump becomes very badly vascularized and that at this level the suture often separates when this technique is followed.

[1] Presse méd., 1921, August 17.
[2] Soc. chir. de Par., 1921, June 8, p. 835.

When the vessels have been ligated, the three-branch elastic clamp is placed. The middle branch is removed and the stomach sectioned along the distal clamp (Fig. 3). The mucous membrane of the stomach, which is clearly visible, is drawn together by a fine continuous suture along the proximal clamp, which is then removed (Fig. 4). With the same suture one unites the musculoserous layers (Fig. 5). In this way the stomach is closed by a two-layer suture which in its turn is covered over with a seroserous continuous suture (Fig. 6). This very carefully made three-layer closure gives far better hæmostatic results than the more rapid but clumsier two-layer suture generally used by hasty surgeons.

The operation is terminated by a marginal posterior gastro-enterostomy which is done as near as possible to the greater curvature. This gastro-enterostomy is made with great care and is of the three plane type.

When the gastrectomy is very extensive I finish the operation with a Pólya, the technique of which is shown in the figures.

CONCLUSIONS

I have tried every method, every technique, every anæsthesia, and have arrived at the following conclusions:

1. Respiratory complications are not dependent on the kind of anæsthesia. They are septic complications associated with the lesion and with the surgical handling which should be as gentle as possible.

2. There is much to gain by care in operating and in making the sutures. As often as possible the sutures are made in layers: mucomucus, seromuscular, seroserous. The sutures are reduced in a few hours to 2 layer sutures and no septic cavity is interposed between the two planes, seromuscular and seroserous.

3. The closing of the duodenal stump by invagination is superior to any other form of closure.

4. The use of the three-branch clamp avoids all soiling of the operative region and makes possible a careful and very rapid closure of the gastric incision.

5. The diaphanoscope while assuring good irrigation of the tissues may be of great service in gastric and intestinal surgery.

THE TREATMENT OF GENERAL PERITONITIS

By GEORGE E. ARMSTRONG, M.D., F.A.C.S., Montreal, Canada

THE treatment of peritonitis involving the pelvic and small intestine area is extremely simple. The operating surgeon only needs courage. I do not mean the kind of courage seen on the battlefield, not the courage of heroic activity, but the courage to stay his hand.

The ancillary sciences have pointed out the way. The great principle that should govern the treatment of general peritonitis has been marked out by the bacteriologists. They have taught us that bacteria produce a poison that is fatal to themselves. A simple illustration is an abcess containing sterile pus. Within the abdomen the bacteria are adherent to the peritoneal surface. No amount of washing or sponging will remove them. They can be destroyed only by the toxins that they themselves create. The manufacture of these toxins goes steadily on. The death of the germ is assured, given sufficient time.

How should we apply this knowledge in a case of general peritonitis associated with a perforated appendix? Obviously by doing nothing to delay the output of the life-saving toxin. Some surgeons are of little faith. They accept the teachings of bacteriology on Sunday, but on Monday they wash or flush out the toxin loaded fluid from the abdomen and then the bacteria recover their activity. The surgeon has been a good friend to the bacteria but to the patient an enemy in the guise of a friend. Indeed some meticulous surgeons spend some time in carefully wiping the coils of intestine and the pelvic cavity with gauze to ensure against the leaving of one drop of life-saving toxin loaded fluid in the abdominal cavity.

It is here that the surgeon needs courage. It is so natural to remove pus from an infected abdomen. It gives him a feeling of duty faithfully done that the world knoweth not of. He goes home at peace with himself and his God. He has done a good thing and done it thoroughly and conscientiously. If the patient does not recover it will certainly not be his fault.

On the other hand to leave an abdomen full of pus, odorless or foulsmelling, requires the courage of a hero. It does not seem right. The justification for doing so is the result.

Coils of intestine that are manhandled douched and, worse yet, swabbed with gauze are provoked to adhere, and mechanical obstruction is not a rare sequence. If the coils are not disturbed adhesions will not form and there will be no mechanical obstruction.

Let the technique then be to deal with the cause of the infection as gently as possible. Pass a small soft rubber tube or an accordion drain nearly, but not quite, to the bottom of the pelvis (*gauze should not be used*), place the patient in the Fowler position and give saline per rectum or intravenously if necessary, and withhold food until the bowels move. The tube is not for drainage but to allow enough fluids to escape to relieve the intra-abdominal tension and thus facilitate the circulation through the blood and lymph vessels.

All patients with general peritonitis treated in this way will recover if the treatment is instituted before paralytic obstruction has developed.

Those who have courage to carry out this treatment will have no mortality in general peritonitis.

OPERATIVE TREATMENT OF ULCERS OF BODY OF THE STOMACH[1]

By A. J. WALTON, M.S., F.R.C.S., London, England

SOME eleven years ago when I was first appointed surgeon to my hospital I was asked to travel abroad to enlarge my surgical knowledge. I at once selected the United States as being the Mecca of all modern surgeons. Since that visit American surgery has not only held its place but has advanced to even higher planes, and thus you will realize how very greatly I appreciate the honor of being asked to read a paper at this the most representative meeting of all that is best in surgery, not only of the United States but of the civilized world. I have, however, been in great difficulty in the choice of a subject, for I could not hope to bring before you anything that was new to you. I have therefore chosen a subject which still presents to me considerable difficulty, in the hope that I may stimulate discussion and thereby obtain rather than impart knowledge.

The treatment of ulcers of the body of the stomach is such a subject, for even today there is no branch of gastric surgery in which so many different views are held and so many operations are advocated. My own experience has led me to take up a definite line of action, and I wish today to discuss with you the theory and the practical results upon which these conclusions are based.

It will, however, be necessary, before putting before you and analyzing the results of my own experience, to briefly discuss the different forms of treatment which are at present advocated. From the point of view of treatment these ulcers may be considered in two main groups. In the first are those examples which are low down on the lesser curve or on the posterior surface close to the lesser curve (Fig. 1). There is a large portion of stomach proximal to the ulcer, which is as a rule generally small. In the second group the lesion is seated far up on the lesser curve, often indeed in close relationship to the œsophageal opening (Fig. 2). It is frequently larger and more indurated and not uncommonly is firmly attached to the surrounding structures. In this latter group, fortunately not very common, the ulcer is so inaccessible that any form of surgical treatment is associated with considerable difficulty. Hence somewhat different lines of treatment will be applicable to the two groups.

ULCERS IN THE CENTER OF THE LESSER CURVE

The following methods of treatment have from time to time been carried out in the treatment of this variety of ulcer.

1. *Gastro-enterostomy* (Fig. 3). Although this operation gives such satisfactory results for simple ulcers at the pylorus or the first part of the duodenum, and especially for those associated with obstruction, it is becoming generally recognized that it is insufficient as a sole means of treatment for an ulcer on the lesser curve. This is more especially the case if the ulcer in this situation has spread through the walls of the stomach and has become adherent to the pancreas or other surrounding structures. Cunning (3) reported a series of cases of adherent ulcers which had persisted in spite of a simple gastro-enterostomy. Mayo, Deansley (5), and Lord Dawson (4) have, among many others, laid stress upon this fact. Deansley and Dobson (6) go further and state that in all cases in which the ulcer is situated remote from the pylorus unsatisfactory results will follow the use of a simple gastro-enterostomy.

My own experience is very definite and convincing. In my earlier series in which these facts were not realized there were 29 cases in which a simple gastro-enterostomy was performed. Of these there were 4 recurrences, a recurrence rate of slightly over 13.7 per cent. In larger series that have been reported the rate has been even higher than this, Deansley placing it at 33 per cent. In addition, however, to these recurrences occurring in patients upon whom I had performed the simple gastro-enterostomy there were 4 patients who had had a gastro-enter-

[1] Presented before the Clinical Congress of the American College of Surgeons, New York, October 20 to 24, 1924.

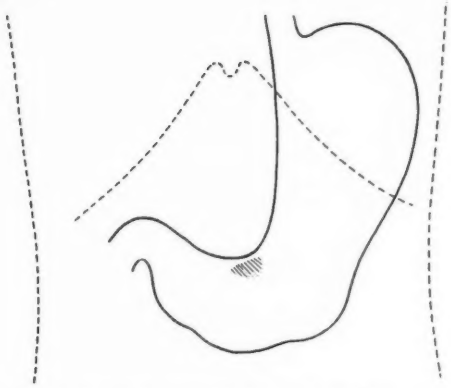

Fig. 1. Group A. Ulcers in the center of the lesser curve. Usually small.

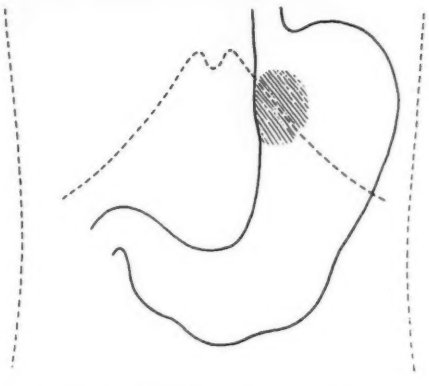

Fig. 2. Group B. Ulcers high up on the lesser curve. Usually very large and adherent.

ostomy performed elsewhere and had then sought my advice for a persistence of their symptoms. A further operation had revealed the fact that the ulcer was still present in the lesser curve. My experience, therefore, of ulcers in this situation persisting after gastro-enterostomy is based on 8 cases.

Of even greater interest than these is a group of 8 cases which I have previously reported, where a gastro-enterostomy had been performed elsewhere not for a lesser curve but for a pyloric ulcer, and, although the original ulcer had healed, a fresh lesion had developed along the lesser curve. In these cases the gastro-enterostomy had even failed to prevent the origin of an ulcer in this situation. Similar cases have been reported by Sir Berkeley Moynihan, Coffeey, and others.

Perhaps an even greater objection to simple gastro-enterostomy is that the ulcer, if left untouched, may become carcinomatous. The question of the relationship between these two conditions has again become controversial, many recent observers believing that only from 5 to 10 per cent of the cases of carcinoma show a past history of ulcer instead of the 60 to 70 per cent which was accepted a few years ago. My own cases show evidence of past ulceration in some 30 per cent.

Whatever is the exact figure there is unquestionably a definite relationship, and Balfour (1) has shown that in 40 per cent of the cases that die after recovery from an operation for gastric ulcer the death is due to the onset of carcinoma. It is true that of his cases 40 out of 75 were those in which there was a large, hard, indurated ulcer high up, and those therefore would not be placed in this group in which the ulcer is small and low down. Nevertheless, in my own series of 29 cases treated by simple gastro-enterostomy one developed carcinoma at the end of 2 years and there have been in my series 6 cases of carcinoma where a diagnosis of this condition was made purely on a change in the symptoms. At operation apparently a simple ulcer was seen, but a partial gastrectomy was performed and a microscopic examination revealed the presence of early carcinoma. Simple gastro-enterostomy must therefore be regarded as an insufficient measure for the treatment of ulcers in this situation.

2. *Excision of ulcers.* In 1881 Rydygier first introduced excision of an ulcer of the stomach as a means of cure. This operation has frequently been performed since, and at one time was largely advocated by Deansley (5) in England.

The essential aim was local destruction of the ulcer, and since this time many other methods having the same aim have been introduced. The following operations are now recognized: (1) wedge resection (Fig. 4); (2) transgastric resection (Fig. 5); (3) stitch resection (Fig. 6); (4) cautery excision (Fig. 7); (5) sleeve resection (Fig. 8).

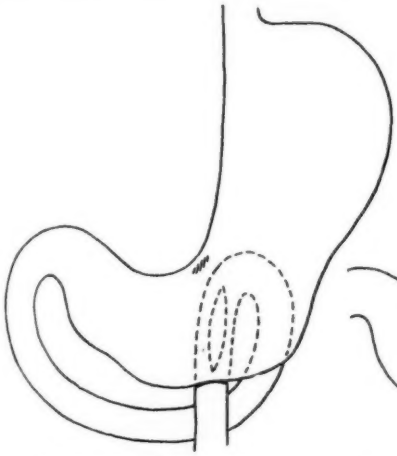

Fig. 3. Simple gastro-enterostomy for lesser curve ulcers.

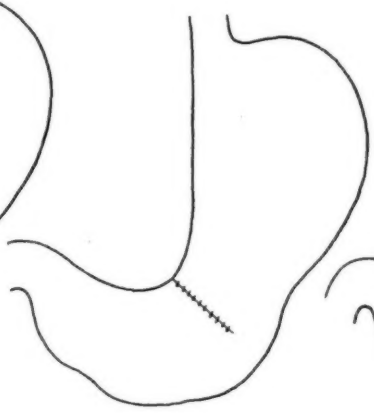

Fig. 4. Wedge resection for lesser curve ulcers.

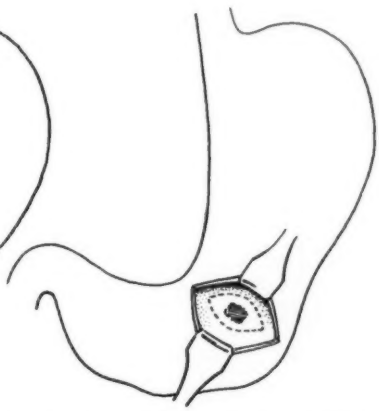

Fig. 5. Transgastric resection of gastric ulcer.

Wedge resection is a procedure which requires a considerable amount of practice before it can be safely performed, but when once the technique has been mastered the results are very satisfactory and the mortality is very low. The ease of the operation will depend upon the size, the position and the extent of the adhesions of the ulcer.

The lesser sac having been opened through the gastrocolic omentum the ulcer is examined from the posterior aspect, and openings then made through the gastrohepatic omentum on the proximal and distal sides of the ulcer. The stomach is clamped on either side, one blade of each clamp passing through the lesser sac (Fig. 9). The coronary and pyloric arteries are tied close to the clamps and divided, a wedge of stomach containing the ulcer is excised (Figs. 10, 11), and first the two edges of the posterior wall of the stomach and then those of the anterior wall are united, each with two layers of catgut (Fig. 12). There is no difficulty in turning up the posterior walls sufficiently to insert the seromuscular layer. Should the ulcer be adherent to the pancreas it is separated after the clamps are applied. This may leave a large opening in the stomach and the base of the ulcer may have to be shaved off the pancreas. The resulting raw area is covered with peritoneum before the stomach is sutured.

At one time Mayo introduced a modification by opening the stomach anteriorly and excising the ulcer through the opening thus made; the posterior opening being then sutured, the anterior wound of the stomach was closed. To this operation he gave the name of "transgastric resection." Draper and McCarty (7) believed that a somewhat similar process of removal could be safely and more simply brought about by inserting a surrounding autolytic stitch which would lead to destruction of that portion of the stomach within its grasp. However, as nearly all these ulcers are situated on the posterior surface of the stomach or on the lesser curve at the attachment of the lesser omentum, it was frequently a very difficult matter adequately to surround the ulcerated area by such a stitch.

It is quite probable that the good results which so often follow the teatment of a perforated gastric ulcer on the anterior surface of the stomach by the insertion of purse-string sutures and the performance of a posterior gastro-enterostomy are due to the fact that the suture which is used as a means of closure acts after the manner of an autolytic stitch, and thus a much higher percentage of cures is brought about than would be expected by comparison with the results which are obtained by the treatment of ulcers of the body by simple gastro-enterostomy.

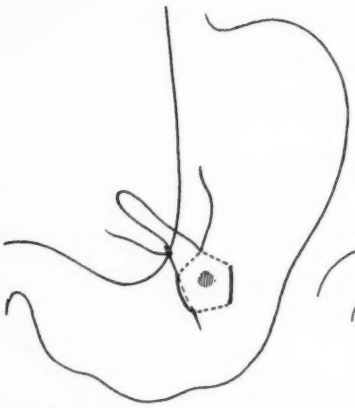

Fig. 6. Stitch resection of gastric ulcer.

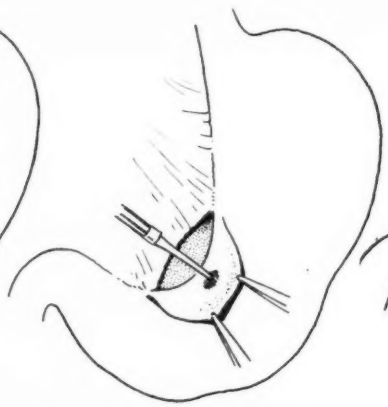

Fig. 7. Cautery excision of gastric ulcer.

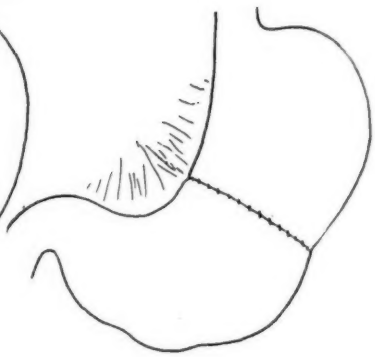

Fig. 8. Sleeve resection of gastric ulcer.

Balfour has devised an operation which in many cases makes the technique very much simpler, and thus has had a very wide vogue. He destroys the center of the ulcer with the actual cautery and closes the opening which is thus left. He maintains that not only does the cautery completely destroy the ulcerated area but that the effects of the heat are widespread and destroy any surrounding diseased area.

Of late there has been, as a result of certain physiological experiments a tendency to replace the resection of a wedge containing the ulcer by the removal of a complete annular segment of the stomach. Clamps are, as in the case of a wedge resection, applied on either side of the ulcer and the complete ring of stomach between them is excised; the ends of the viscus are then united by suture. This operation has been given the name of "sleeve resection." Stewart and Barber (18) claim to have found experimentally and clinically that a wedge resection gave rise to a greater impairment of motility of the stomach than did a sleeve resection, the former operation having a tendency to be followed by dilatation and a decrease of the muscular contractions. Pannett (16) claims that a complete division of the nerve fibers removes the inhibitory influences, and has even gone so far as to advise an operation consisting of a circular incision right round the stomach through the muscular coats only, and in this way is similar to the effect brought about by a sleeve resection.

My own experience, which is based upon a series of careful observations of the X-ray appearances after wedge resection, does not support the view that such an operation is followed by an impairment of the motility; hence there seems to be no indication for replacing this relatively simple procedure by the longer and more difficult sleeve resection.

Judd and Lyons (13) obtained good results in a series of 90 cases, 70 being cured, although pointing out that sleeve resection has theoretically the following objections: (a) it is more difficult than wedge resection; (b) it shortens the lesser curve; (c) it removes too much normal stomach; and (d) an hour-glass constriction may follow. Subsequent X-ray investigations showed that there was a slight hour-glass constriction in 5 cases. They found this method easier than wedge resection and believe that its dangers have been exaggerated.

Balfour (1) in his valuable studies on carcinoma following gastric ulcer found in a series of 56 cases healed by this method no case of later carcinoma, while with all other methods there was a definite percentage mortality due to this cause. A possible explanation of these figures may be, however, that the sleeve resection was mainly performed for hour-glass constriction—a condition which very rarely becomes carcinomatous.

These various methods of local excision of the ulcer fell into very considerable disrepute, for it was found that if the ulcer had been

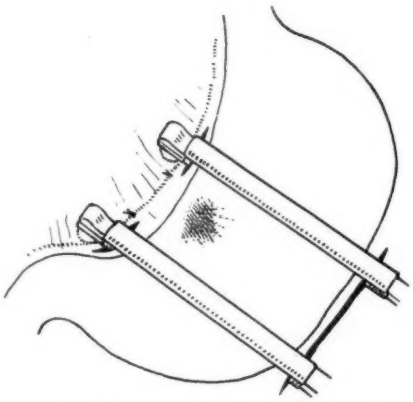

Fig. 9. Wedge resection. Application of clamps.

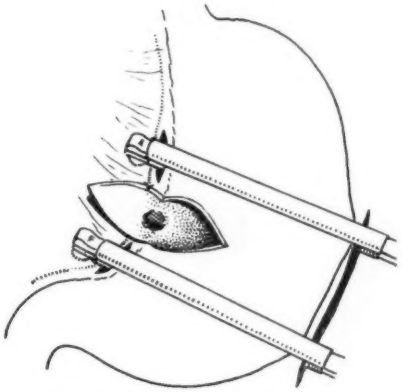

Fig. 10. Wedge resection. Anterior wall excised

excised there was a tendency for a new ulcer to form. This was indeed only to be expected, for if there were certain conditions in the stomach which would lead to the formation of an ulcer in the normal viscus, how much more likely was it that they would lead to ulceration of traumatized areas such as are left after any form of resection. Poor results from these methods alone have been reported by many surgeons, and it may be now accepted that if no steps are taken to prevent the recurrence of ulceration the results are almost certain to be bad. Balfour found that such methods alone were only followed by 57 per cent of cures, and Sherren has reported that of 9 cases, 1 died and only 2 remained well. My own experience has been very similar. It would be expected, however, that if the operation of local destruction or removal were combined with some step which would overcome the tendency for ulcer formation, then the results would be very satisfactory. Such a result is obtained by combining with the resection a gastro-enterostomy.

It is my own custom to perform this operation on the posterior surface, the opening being so placed that it lies transversely, half of it being proximal to the line of suture following the resection, while half is distal. This means that the gastro-enterostomy opening is placed relatively high up and it is probably for this reason that there is such a definite neutralization of the stomach contents and that the clinical results are so satisfactory. Of the various methods of excision which should be combined with a gastro-enterostomy my own preference is strongly in favor of a wedge resection as a routine form of treatment. This operation is relatively easy to carry out, a good approximation can be brought about by the line of suture, all hæmorrhage can be easily controlled and the line of excision can be so planned that the whole of the diseased area can be removed, leaving soft pliable walls to be approximated.

Theoretically one of the grave objections to a sleeve resection is that it cannot adequately be combined with a gastro-enterostomy. The line of suture is so placed that a gastro-

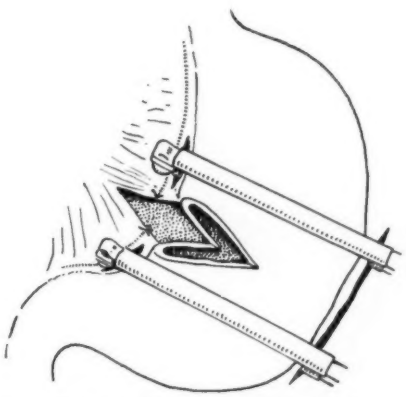

Fig. 11. Wedge resection. Excision completed

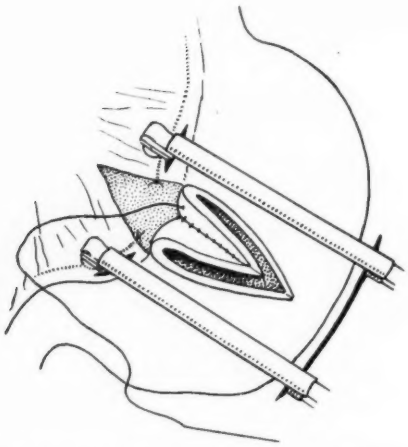

Fig. 12. Wedge resection. First the two edges of the posterior wall of the stomach and then those of the anterior wall are united, each with two layers of catgut.

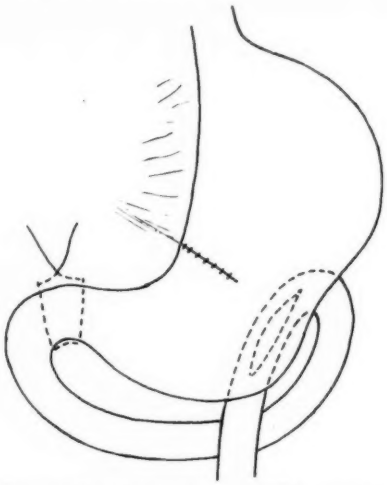

Fig. 13. Complete operation. Wedge resection. Temporary occlusion of pylorus. Posterior transverse gastro-enterostomy.

enterostomy either cannot be made proximal to the suture or would have to be very high up on the fundus of the stomach, whereas if placed distal to it, it is probable that its effects would not be very beneficial.

The stitch operation as a routine form of treatment is generally unsatisfactory and difficult to carry out, although, as I have pointed out, it probably has very beneficial effects with a perforated ulcer, which is nearly always situated anteriorly.

The cautery resection of Balfour, I do not advocate as a routine form of treatment, for my own belief—which I must admit is very largely theoretical—is that it does not give so complete and wide a removal of diseased tissue as does a wedge resection, and, moreover, is likely to leave a larger area of destroyed tissue which must be removed by a process of ulceration. In certain cases, however, where the ulcer is situated on the posterior surface and is easily accessible through the gastro-colic omentum, this method of Balfour is admirable and is most simple to carry out. I have used it in several such cases and the results have been in every way satisfactory.

The transgastric resection is hardly ever necessary and suffers from the drawback that the line of suture cannot be so adequately carried out, and indeed has to be limited to one layer of suture material. Mayo himself has recognized this difficulty. It has therefore become my custom as a routine form of treatment to perform a wedge resection which is combined with a posterior gastro-enterostomy. Since all the diseased tissue has been removed, it is probable that there will no longer be any pyloric spasm, and hence there may not be complete diversion of the stomach contents through the stoma. For this reason the pylorus is occluded, but it is recognized that such an occlusion need only be of a temporary nature, and it is therefore carried out by means of a running mattress suture of silk which later allows the pylorus to open. My own observations, carried out in a follow-up department by means of X-rays, show that the pylorus as a rule begins to open between the second and third month.

In my own practice I have had 244 cases of ulcer of the body of the stomach. A wedge resection combined with temporary pyloric occlusion and a posterior gastro-enterostomy has been carried out in 135 cases of simple ulcer low down on the lesser curve, in 8 cases where an ulcer had developed after a gastro-enterostomy performed elsewhere and in 19 cases which were complicated by hour-glass

constriction. It is of interest to note that the 143 cases uncomplicated by hour-glass constriction were comprised of 103 males and 40 females, whereas the 19 hour-glass cases were all females. I rather specially lay stress upon these figures, for in my experience—which appears to be contrary to that of some other observers—all ulcers of the stomach, whether of the body or of the pylorus, are much more common in males. Hour-glass stomach, on the other hand, is practically wholly limited to females, and this condition also has shown no tendency to become carcinomatous. It would therefore appear to be important in comparing the relative values of different forms of operation to consider the hour-glass cases in a group apart (Table I).

TABLE I

Total ulcers of body of stomach							244
Wedge resection							
(a) Simple ulcers							135
(b) Recurrent after gastro-enterostomy							8
Males	103						
Females	40	Total					143
(c) Hour-glass							19
							All females.

Without constriction

	Total	Operation deaths	Per cent	Traced	Cured	Slight symptoms	Per cent
	143	3	2	117	99	8	91
Hour-glass	19	2	10.5	17	13	3	84.2

The mortality of the combined operation should be very low, for the amount of operative shock is slight, and as a general rule the pulse is increased little if at all. In my series of 143 simple cases there were 3 operative deaths. Of these 3, 1 was a man of 70 who died from cardiac failure, and another was a patient who developed an abscess of lung which led to his death nearly 4 weeks later, and one would hope, therefore, that in future even this mortality should be reduced. These figures give a percentage mortality of very slightly over 2. In the hour-glass cases, where the patient is generally a frail woman who has long suffered from ptosis and has been much weakened by prolonged vomiting and loss of appetite, it would be expected that the mortality should be somewhat higher. Of my 36 cases of non-malignant hour-glass stomach 19 were treated in this manner, the base of the resected wedge being made specially wide so that when the stomach was sutured the narrowing was overcome. Of this group 2 died as the result of operative interference, giving a mortality of 10.5 per cent.

It is, however, of the late results of the simple cases treated by this method that I specially wish to speak. Since 1919 I have had a well-equipped follow-up department and have been able to trace my cases in a most satisfactory manner. I may say here that I believe that it is essential for any up-to-date surgical unit to have such a department, for unless one keeps in close contact with the patients it is probable that a much too optimistic view will be taken of the results of treatment, and operative measures will be continued which are in reality unsatisfactory. I had not the benefit of this department for the cases operated upon before 1919, and therefore a good many of this group have been lost sight of or have only been traced for a relatively short period. Thus it is that of the 143 cases late reports have been obtained of only 117. Of this group, however, 99 are absolutely well. They perform a full day's work, live a normal life and have a full diet. They complain of no symptoms of any sort. A further 8 cases complain of occasional slight flatulence or discomfort, for which they take a little alkali. With this they also are able to live a full and complete life. Hence 107, or 91 per cent, have been converted from unfit to fit members of the state.

Of the remainder 1 has had a true recurrence at the site of the excision. Why in this case there should have been such a recurrence when the gastro-enterostomy was apparently working well and the ulcer had been excised, I do not know. That it was not due to the onset of carcinoma was proved, for later a partial gastrectomy was performed and no sign of carcinoma could be found microscopically. One case developed carcinoma at the site of the excision. This occurred 1 year after the primary operation. Unfortunately I find that the first operation was carried out during the war and that microscopic sections were not cut, hence it is not possible to say that the carcinoma was not present at the time of the first operation. It probably was, for the condition a year after operation was definitely carcinomatous. One has developed carcinoma at the pylorus quite apart from the site of the

ulcer on the lesser curve. Two patients have died since operation; 1 from a lung condition which probably owed its inception to the anæsthetic. In accordance with the usual experience with this variety of ulcer there has been no example of a subsequent gastrojejunal ulcer.

3. *Partial gastrectomy.* It is becoming more and more the custom to treat ulcers of the body of the stomach by a partial gastrectomy, and a large number of papers have been written to show that the mortality can be reduced to a very low figure by this operation. That the mortality can be and has been reduced to 3 per cent or under by surgeons specially practicing this branch of surgery will be admitted, but if the operation is performed as a routine measure for these smaller ulcers low down on the lesser curve I am convinced that, except perhaps in the hands of one or two surgeons, the mortality will be very much higher than if more local steps are practiced. The actual figures are extremely difficult to compare, for on the one hand a partial gastrectomy is unquestionably possible in some advanced cases of ulceration where any form of local excision would be quite out of the question, but even if these cases, which are bound to be associated with a high mortality, are eliminated, the figures will still be confused; for if a surgeon performs a partial gastrectomy as a routine step he will include in this group all the smaller ulcers, and his figures will show a low mortality, whereas a surgeon who practices local resection will reserve the partial gastrectomy for the more advanced cases, and hence the operation in his hands will appear to be dangerous. Mayo (14) has shown that the mortality can be reduced to 3 per cent or under, and similar satisfactory figures have been reported by Sir Berkeley Moynihan. Other surgeons, who like myself use the partial gastrectomy only for the more difficult varieties or for those showing some suggestion of carcinoma, will have a much higher mortality. In my own hands there is thus the curious anomaly that a partial gastrectomy for an innocent lesion has a higher mortality than when performed for carcinoma.

The variation in the figures of the operative results according to the cases for which the different methods are used is well shown by the statistics of Finsterer (8) who, in his last 158 partial gastrectomies, had a mortality of only 1.8 per cent, but the mortality for his cases of simple gastro-enterostomy, which was apparently only used for advanced cases, was 11.8 per cent.

It must be remembered here that the very low mortality which is obtained by these skilled surgeons is in one way likely to be harmful to surgery, for amateur surgeons who perform major operations once or twice a year are in the habit of quoting them to their patients, who thus believe that these results can be obtained by any surgeon however small his knowledge and experience.

The other great objection to the operation is that so large a portion of a perfectly normal viscus is removed. It is quite true that patients with seven-eighths or more of their stomachs removed appear to live perfectly happy and normal lives and to have no evidence of disability, but nevertheless a partial gastrectomy for a small ulcer 1 centimeter or less in diameter high up on the lesser curve, or for an hour-glass stomach with a relatively wide canal and the constriction so placed that the pyloric pouch forms three-fourths or more of the stomach, gives rise to the feeling that the operation is much too radical and that it is unnecessary to sacrifice so large a portion of healthy stomach. In this feeling I am evidently not alone, for Dr. W. J. Mayo (15) has also drawn attention to the danger of the more general introduction of so radical an operation because some 6 per cent of cases of duodenal ulcer and some 10 per cent of gastric ulcers are not relieved by gastro-enterostomy. Hurst (12) believes that achlorhydria is the primary factor in pernicious anæmia and that after a partial gastrectomy there is a real danger of the onset of this condition. He states that he knows of 5 cases in which such a complication occurred. It is, however, too early as yet to accept these views as correct.

If, then there are real objections to removing so large a portion of the stomach, and the operation is associated with a higher risk, one has to ask one's self what are the corresponding benefits. The claims made for this operation are that there is no possibility of a gastro-

jejunal ulcer following and that the risk of the onset of carcinoma is very much diminished. The first claim is incorrect. All surgeons are agreed (and my figures support this) that there is little or no danger of an anastomotic ulcer following any operation for an ulcer of the body of the stomach. When the ulcer is situated at the pylorus or duodenum an ulcer at the junction may occur after a partial gastrectomy as well as after a gastro-enterostomy. I have had to operate for 2 such cases where a partial gastrectomy had been performed elsewhere, and similar cases have been reported by Beer (2), H. Haberer(9), Hoquet and Cole (11), and Wright(19). Von Haberer(10) states that he has returned to the Billroth I operation owing to the number of gastrojejunal ulcers following the Billroth II and Pólya operations.

The possibility of carcinoma after the more local methods of removal must be inquired into, for should this be a real danger a partial gastrectomy should certainly be the operation of choice, even if it has a slightly higher immediate mortality. The risk of this complication should be much less when the ulcer is removed by wedge resection than after a simple gastro-enterostomy, and it would seem unlikely that carcinoma would arise after the wound had completely healed. Balfour (1) has shown that 40 out of 76 cases that later became carcinomatous showed this change within two years of the operation, and were thus probably already carcinomatous when the operation was undertaken. Sherren (17) also reports 5 cases of carcinoma following a gastro-enterostomy in which the time of onset of carcinoma varied from 2½ to 18 months after the operation. In my complete series of cases there have only been 2 cases of late carcinomatous change at the seat of the ulcer. In one of these a gastro-enterostomy was alone performed, so that in only one has this change arisen at the site of the excision. It is important, however, to remember that even in the early stages of such a change there will often be an alteration in the nature of the symptoms. The periodicity may be lost, the pain may become less severe but more continuous, the appetite may begin to fail and vomiting may cease to give relief. Under such circumstances a partial gastrectomy should be performed even if the ulcer appears to the naked eye to be quite free from growth. I have already mentioned that in 6 of my own cases carcinoma was found under such conditions. My own view, therefore, is that the danger of the late onset of carcinoma is very slight if care be taken over the diagnosis, and is not sufficient to warrant the routine performance of partial gastrectomy. For ulcers easily accessible on the lesser curve local removal with gastro-enterostomy should be the operation of choice. If there is the slightest suspicion of carcinoma, partial gastrectomy should be performed.

LARGE ULCERS HIGH UP ON THE LESSER CURVE

Cases are seen from time to time in which the ulcer is situated so high up on the lesser curve that it nearly, or sometimes indeed actually involves the cardiac opening. These ulcers probably give relatively late symptoms, and thus it is that they are often found to be extremely large and adherent to the posterior abdominal wall. Owing to their size and to their adherence they are often very difficult to deal with surgically, and in fact it would be in many cases quite impossible to excise them locally. The freer access which is given by a partial gastrectomy will often allow of their removal, but it frequently happens that when the operation has been started it is found that the removal consists of a sub-total or even of a complete gastrectomy. Such an operation is associated with a high mortality, and it becomes a very doubtful question whether it is justifiable. Nor is the argument sound that many of these ulcers are carcinomatous, and that the only possible chance of a cure is by performing a complete gastrectomy, for if an ulcer so situated and so extensive in size be already carcinomatous it is almost certainly too far advanced to allow of a radical cure. In such circumstances it is a very difficult matter to decide what is the best operative procedure.

Many surgeons (and at one time I was among them) are in the habit of performing partial gastrectomy, for no other procedure seems at first sight likely to hold out any

chance of success. Sir Berkeley Moynihan has recognized the difficulties which are associated with this type and has advocated a jejunostomy which is kept open for a long period so as to give that portion of the stomach a complete rest. To my mind there are very definite objections to this operation. The patient during the whole period during which the jejunostomy is acting—and it may be necessary to keep this open for 2 years—is more or less a complete invalid, and a life during which all food has to be ingested through an abdominal tube can hardly be described as worth living. The ulcer is quite inaccessible for cautery, stitch, or wedge resection, and a partial or complete gastrectomy has a very high mortality. With this latter operation there is the danger that as the surgeon's skill improves he will attempt more and more difficult cases, but he will find in the course of time that the mortality is rising and he will have to halt. This has been my own experience, an experience which I believe I share with many surgeons. I have found that a partial gastrectomy, which in the past I reserved for these large and difficult ulcers or for those which had evidence of carcinoma, gives a mortality approaching 16 per cent.

I believe that the most satisfactory results in such cases will be obtained by simply performing a posterior gastro-enterostomy as high up as possible at the first operation. Such a procedure will in these high ulcers give a certain percentage, usually estimated at about 40 per cent, of complete cures. In some of the remainder the patient will experience complete relief for a period of about 1 year or 18 months. He then will have a return of his symptoms. If a second operation is now carried out the ulcer will be found to be much smaller, and a local excision, either with a knife or the cautery, will be found possible. I have had in my own series a group of 5 cases in whom the second operation has been followed with very favorable results and complete cure. It is true that in a certain number of such cases where the first operation has been performed, and the patient has been left with the idea of carrying out some more radical step at a second operation, the condition has progressed and at a later period it has been found that the patient is suffering from inoperable carcinoma. It is almost certain, however, that if a partial gastrectomy had been carried out at the first operation, even if the patient had survived, a recurrence would have taken place with so high and so extensive an ulcer. It is a matter of very considerable difficulty for the surgeon to judge when to perform a partial gastrectomy and when only to undertake a simple gastro-enterostomy, for if the ulcer be non-malignant it is not justifiable to subject the patient to an undue risk. On the other hand if it is thought to be malignant the gastrectomy should only be undertaken if there appears to be a good possibility of complete removal.

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THE RELATION OF THE SPLEEN TO CERTAIN CHRONIC PURPURAS[1]

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FROM the obscure symptomatic purpuras, a clinical entity has emerged which in the typical case is sufficiently definite to take the name of essential thrombocytopenic purpura, after its most important characteristic. Viewed in perspective, it forms a satisfactory picture. Examined in detail, the picture fades, and the condition shades back into the obscurity from which it sprang.

Thrombocytopenic purpura has five distinguishing characteristics: (1) chronic hæmorrhagic purpura, (2) deficiency of blood platelets, (3) greatly prolonged bleeding time, (4) non-retractile blood clots, and (5) usually enlargement of the spleen.

It is my purpose to evaluate briefly these criteria, as well as I may, in the light of our present inadequate knowledge, with the hope of stimulating an interest in the pathological changes in the blood that lie behind the purpuras generally.

HÆMORRHAGIC PURPURA

Hæmorrhagic pupura is a visible sign of a blood dyscrasia. Remissions often occur in the purpuras, and the history is therefore very important. If, because the patient is seen during a remission, the diagnosis is doubtful, the application of a tourniquet (capillary resistance test) to the arm for 3 minutes with just enough pressure to obstruct venous return but not to interfere with arterial circulation, will usually produce typical petechiæ.

Attempts have been made at various times to make entities of certain symptomatic purpuras, such as the so-called rheumatic purpura of Schoenlein and Henoch's purpura, but the foundation in fact is too slender to justify an eponym. In the occasional case of purpura of this type, the symptoms are distinctive, but in most instances the syndrome shades off into other purpuric conditions.

Purpura may be seen in the terminal stages of many diseases, such as chronic nephritis, cirrhosis of the liver, pernicious anæmia, and the chronic aplastic anæmias, the leukæmias, tumors of the bone marrow, and some cases of splenic anæmia. Poisoning by certain chemicals, benzol, for example, is marked by the development of definite purpura.

Acute purpura is seen in connection with certain exanthemata, notably scarlet fever, and hæmorrhagic (black) smallpox. One of the most distinctive of the acute purpuras occurs in the acute aplastic anæmias, which usually affect persons between 15 and 30 years of age, and sometimes run their entire course to a fatal ending, in from 3 to 6 weeks. In the acute leukæmias, purpura is frequently observed.

It will be seen, therefore, that the names given to the purpuras are merely convenient pegs on which a miscellaneous assortment of conditions more or less resembling each other are hung. From time to time these syndromes are shifted from one peg to another as knowledge of the underlying disturbances of the blood advances. While we assume that a blood dyscrasia actually exists in all of these cases, we frequently have no method of demonstrating disease characteristics in the blood.

DEFICIENCY OF BLOOD PLATELETS

The red blood cell is formed in the bone marrow. It has no nucleus and therefore has no power of growth or of directly contributing to the growth of other tissues. It is the oxygen carrier and contains hæmoglobin, to each molecule of which iron contributes one atom.

In 1882, Bizzozero first described the blood platelet. In 1906, Wright showed that the blood platelet was formed by the megakaryocytes of the bone marrow. Certain observers have been inclined to consider the blood platelet an alteration of the red blood cell rather than a cousin. Leddingham, in 1914, and later, Benson, demonstrated that the blood platelets are an independent element in the blood, and further study has shown

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that they are concerned in the clotting of the blood.

Normally the blood platelets vary between 200,000 and 400,000 to each cubic centimeter of blood, with 5,000,000 red cells and 5,000 white cells. When the blood platelets are reduced below 100,000, there is a tendency to the development of purpura, and when they consistently number less than 80,000, manifestations of purpura will probably be found. When they fall below 10,000, purpura is a prominent symptom. It is probable that in the purpuras there are pathologic changes as yet unrecognized in the blood platelets, as well as a deficiency in the number.

PROLONGED BLEEDING TIME

When marked deficiency of the blood platelets exists, prolonged bleeding, perhaps up to 1 or 2 hours, results from slight injuries. Mastication of rough food may cause prolonged bleeding from the mucous surfaces of the mouth. Menstrual flow in purpuric women may be very greatly aggravated, and may not be checked without extreme difficulty, if at all. Any type of operation is likely to be followed by serious oozing of blood.

In the acute purpuras frequent transfusions of moderate amounts of blood are the best remedy, and, if the purpura is dependent on a self-limited disease, recovery may follow. The chronic purpuras demand transfusions of blood and removal of all possible causes of the underlying blood disease, such as foci of infection.

FORMATION OF THE BLOOD CLOT

In the purpuras the blood coagulates, but the clot does not undergo normal retraction and exudation of serum. There are four important factors in the coagulation of blood: (1) thrombin, which causes coagulation, and exists in the blood normally as the inactive form, prothrombin; (2) antithrombin, which prevents the activation of prothrombin; (3) various tissue juices, one of which, known as thromboplastin, escapes into wounds, and by neutralizing the antithrombin favors the release of the active thrombin and therefore the formation of the clot; and (4) fibrinogen which is present as a hydrosol in normal blood, but is transformed into the hydrogel, fibrin, by thrombin. The blood platelets probably assist in the reaction by providing not only prothrombin, but a second substance, when they disintegrate or during hæmorrhage, which acts like thromboplastin. Coagulation depends as well on the presence and chemical state of calcium in the blood. Although these facts, and very many less important ones, concerning the mechanism of the excitation and prevention of coagulation, are generally accepted, with more or less reserve, it has been even more difficult to explain the variation in retraction of the clot. It is significant, however, that diminution of platelets is more accurately reflected by variations in retractility than it is by any other phase or feature of abnormal coagulation.

In hæmophilia, the blood does not clot. The disease is said to be found only in males, carried by the mother to the male children. It may be due to absence of prothrombin or other little known substances from the blood or to qualitative changes in the platelets. Although the blood does not clot, the bleeding time is not greatly prolonged. The number of blood platelets is not diminished. However, the diagnosis of hæmophilia rests largely on the heredity and history, since the blood often shows but few abnormalities on such tests as are at our command.

In the purpuras, the blood clots, but there is a prolonged bleeding time because of the blood platelet deficiency. In cases of chronic jaundice, the bile salts and pigments, by uniting with the blood calcium, determine a calcium deficiency in the blood plasma, which often gives rise to purpuric manifestations. Calcium deficiency is remedied by the intravenous introduction of chloride of calcium. It has been found experimentally that certain sterilized tissue extracts of the thromboplastic type, for instance, that made from brain tissue, will shorten the clotting time of the blood, and on the contrary, that an extract made from liver tissue by enhancing the action of antithrombin, will prevent coagulation for many hours after its injection. It is interesting to note that there is no apparent connection between prolonged bleeding time

and deficient coagulation. While the two symptoms may be found in the same patient, they depend on different causes.

ENLARGEMENT OF THE SPLEEN

Enlargement of the spleen is frequently found in thrombocytopenic purpura, but it is not always easy to detect. The situation of the spleen is such that percussion is of little value in the diagnosis. The spleen must be at least twice the normal size before it can be felt on palpation during deep inspiration. Often the enlarged spleen becomes adherent high under the diaphragm so that it is not greatly affected by respiration, and may be three or four times normal size before it can be palpated beyond the free margin of the ribs.

The spleen is a lymphoid organ with a relatively large blood supply, so that it is sometimes called a hæmolymph organ. In health its function is unimportant and its removal causes no disturbance in after life.

One of the functions of the spleen is to destroy worn out or deteriorated red cells. Anything which reduces the number of red cells reduces the amount of oxygen carried to the tissues, resulting in the suboxidation called anæmia. It is not surprising, considering the close relationship between the red cells and the blood platelets, that the spleen should attack both. That this is the case in thrombocytopenic purpura, we know, because the platelets in the blood are diminished and the splenic sinuses, when the spleen is removed for thrombocytopenic purpura, will often be found crowded with blood platelets. The rapid return of the blood platelets to normal after removal of the spleen constitutes additional proof.

The spleen contains differentiated tissues and is one of the structures which produces lymphocytes. The reticulum cells of the splenic pulp are very similar to those in the lymph nodes, and the splenocytes or monocytes are perhaps the most efficient of all the phagocytes in combating infections.

Wysokowitsch has shown the extraordinary rapidity with which intravenously injected bacteria are taken up by the endothelial cells of the liver, spleen, and bone marrow. Jordan visualizes the spleen as a vascularized mass of lymphocytes supported by a slightly differentiated mesenchyme called the reticulum, which is the mother tissue of the lymphocytes. He divides the lymphocytes into three groups: granulocytes, monocytes, and those which under stress will produce erythrocytes.

Carrell, in his work on the immortality of tissue, speaks of the lymphocyte as the carrier of the necessities of life to the fixed connective tissue cell, and points out that repair of injured tissue depends on the lymphocyte.

In 1913, Landau and Aschoff proposed that these various types of white cells be differentiated from the leucocytes and grouped separately, and to the body-wide tissues which produced them they gave the name of the reticulo-endothelial system.

Herring and MacNaughton, in their fine study of the lymphatic system, referred to the process by which particles insoluble in water, such as micro-organisms, and foreign material are removed from the tissues by phagocytosis; that is, these particular substances are picked up and carried by diapedesis into the lymphatics, where they are detoxicated and broken up in the sinuses of the lymphatic plexuses of the lymph nodes.

The enlargement of the lymph nodes is the result of the struggle to destroy, or to prevent the advance of bacterial, protozoal, and cancerous infections, into the general circulation through the thoracic duct. The enlargement of the spleen in typhoid fever, malaria, and syphilis, is witness to the attempt to remove disease organisms that have gained entrance to the blood stream. The slowing circulation in the splenic sinuses creates a favorable opportunity for the reticulo-endothelial cells to attack and destroy the intruders. The products of the struggle are carried to the liver through the portal vein. One of the causes of our frequent inability to cure syphilis of the nervous system lies in the fact that the central nervous system has no lymphatics. The nerve cells are insulated from the blood stream by the neuroglia, and when the spirochætæ once enter the nerve cell it is exceedingly difficult, often impossible, to destroy them.

Unfortunately, an enlargement of the spleen, even a work hypertrophy, increases its ability to destroy red cells. In the presence of splenic enlargement, an anæmia practically always exists, although there may be stages of remission. It is not suggested that splenic enlargement offers the whole solution of the problem of undue destruction of certain elements of the blood, but the potentialities for evil are increased with hypertrophy, whatever the cause of it may be. A working hypothesis might be deduced that these differentiated splenic cells have varied functions, that one type of cell attacks the red cells of the blood, another the blood platelets, and so on. Or, the spleen may be freed from blame on the assumption that under certain toxic conditions, the bone marrow is unable to produce normal cells, and in the course of the day's work the spleen removes the abnormal cells, although they are the best the bone marrow can produce and are capable of sustaining life. Such an explanation might also apply to the destruction of blood platelets.

Differential diagnosis in thrombocytopenic purpura depends on a relative deficiency of the blood platelets. In the purpura of the acute aplastic anæmias, while the blood platelets are reduced, the red cells and the white cells are equally reduced. This is true also in cases of bone-marrow tumors and chemical poisoning. In the purpura of leukæmia, the red cells and the blood platelets are reduced, but the white cells are relatively not reduced, and there are also the characteristic leukæmic changes in the structure of the white cell. In the purpura of pernicious anæmia the reduction of white cells, red cells, and blood platelets, on the contrary, is proportionate, but the change in structure of the red cell is of diagnostic importance.

Unfortunately, in many suspected cases of thrombocytopenic purpura the signs and symptoms are blurred. It is only recently that the aplastic anæmias have been separated from the pernicious anæmias, and many cases are seen in which a differential diagnosis of the two conditions is not as yet possible. Then, again, there are cases of suspected thrombocytopenic purpura which cannot be differentiated from chronic aplastic anæmia or pernicious anæmia. Milder grades of hæmophilia are undoubtedly more common than we have supposed, and sometimes cannot be differentiated from thrombocytopenic purpura. It is possible that the cases of so-called hæmophilia in the female are, in most instances at least, examples of thrombocytopenic purpura.

Kaznelson, in 1916, was the first to suggest splenectomy in cases of thrombocytopenic purpura hæmorrhagica. We have removed the spleen in 10 cases of typical thrombocytopenic purpura with no operative mortality. The condition of some of the patients before operation was extremely poor, but by repeated transfusions of blood, it was improved sufficiently to make splenectomy justifiable. Recovery in each instance was rapid. In 72 hours the platelet count jumped from under 80,000, in several cases under 40,000, to normal or above. The increase in platelets was not maintained in all cases. Several of the patients before dismissal had blood platelet counts of under 200,000, but these patients have all remained well. My colleague, Doctor Giffin, and his associates, have reported these cases in detail.

ABSTRACTS OF TWO CASES ILLUSTRATING CONFUSING BLOOD PICTURES

CASE 1. An anæmic man, aged 40 years, came under observation January 2, 1925. He had had frequent hæmorrhages by mouth and by bowel for 3 years. Recently he had had a severe gastro-intestinal hæmorrhage, which threatened his life, and he had been treated for gastric ulcer. When 18 years of age, he bled for several days following extraction of a tooth. He bled unusually long from cuts while shaving, and lost a great deal of blood following lancing of an infected thumb. He had 3 brothers and 1 sister. One brother died during an operation on the hip from uncontrollable bleeding. There were no other instances of familial bleeding. Roentgen-ray examination of the stomach was negative. The blood platelet count was 178,000. Coagulation time by the Boggs method was 8 minutes; the bleeding time was 3½ minutes; coagulation time by the Lee method was 16 minutes; the calcium time was 14 minutes. The prothrombin time was slightly prolonged, and the tourniquet test was negative.

The family history, the long coagulation time by the Lee method, with the normal bleeding time and slight prolongation of the prothrombin time indicated a mild type of hæmophilia. Abdominal exploration was advised, and was accepted by the

patient, a physician. He was prepared for operation by blood transfusions.

On exploration through an epigastric incision January 8, 1925, the spleen and liver were found to be normal. The appendix contained large fæcal concretions and was removed. There was no ulcer of the stomach. On the anterosuperior wall of the duodenum, 2 centimeters below the pylorus, was a small contracted area, but no definite ulcer. The supraduodenal vessel of Wilkie was extremely large and terminated in this contracted area, which was surrounded by numerous varicosities. Five centimeters of the supraduodenal vessels were excised. Owing to uncertainty as to the presence of a duodenal ulcer, a purse-string suture was applied in and out to surround the contracted area, turned in and tied tight, and the area covered with catgut sutures.

The patient was given a transfusion of blood immediately after the operation. There was serious bleeding from the wound in the abdominal wall, and pressure and the introduction of more sutures only partially controlled the oozing. Four postoperative transfusions were given, and after each there was a temporary reduction in the bleeding. The blood clotted, but in large, non-retractile clots, forming hæmatomata of considerable size. These were removed from the abdominal incision several times with a curette, and further sutures introduced. In the second week after operation there was evidence of fluid in the lower abdomen, with a slow percussion wave, which was believed to be blood. The patient gradually recovered and was dismissed at the end of the sixth week, in fair health.

Here was a case with the clinical characteristics of hæmophilia and the wound complications of thrombocytopenic purpura, with a fairly normal blood picture and a normal spleen.

CASE 2. A girl, aged 9 years, came under observation June 4, 1924, on account of anæmia, purpura, and attacks of epistaxis over 8 years. The first attack of epistaxis occurred at night during sleep when the child was 14 months of age. Six weeks later the patient contracted measles and had severe epistaxis which lasted an entire night, and recurred at irregular intervals of from 1 week to 2 months. The hæmorrhage was so severe that it was necessary each time to pack the nose. The last attack had occurred 2 weeks before examination at the Clinic. The child was practically never without purpuric spots. She had been given 2 transfusions in the last year. Prolonged bleeding time on slight injury was a pronounced feature. Extraction of a tooth caused a hæmorrhage lasting 24 hours which was checked only by transfusions of blood. She had had influenza, and scarlatina at the age of 5 years.

The patient was an anæmic, bedridden child, reduced in weight. There were purpuric spots on the legs, thighs, and in the mouth. The spleen was not palpable. Examination of the blood showed the hæmoglobin 30 per cent; red blood cells 2,500,000; blood platelets, lowest count 180,000, highest 340,000. The coagulation time was 5 minutes, calcium time 6 minutes, 40 seconds. The tourniquet test was positive; the blood clot did not retract in 12 hours.

The patient was kept under medical treatment in the hospital for two months. An attempt was made to get the mouth into better condition, and a number of transfusions of blood were given. Fibrogen, coagulen, thromboplastin, epinephrin, calcium chloride, and so forth, were tried, but the purpura and tendency to bleeding were not influenced.

Surgical intervention seemed justifiable, and splenectomy, therefore, was performed August 3, 1924. The spleen was enlarged and adherent. During the operation, hæmatomata formed in the deep tissues as soon as they were handled, which does not ordinarily occur in the typical case of thrombocytopenic purpura. The abdominal incision bled to such an extent that transfusions of blood were given on the operating table. The incision was most carefully sutured and pressure applied, but the bleeding continued and repeated transfusions were given, using blood from several donors. On one occasion the child was given 3 transfusions of blood (500, 130 and 450 cubic centimeters) in a period of 24 hours. For 4 days death seemed imminent, then gradual improvement began; the exuded blood clotted with soft, non-retractile clots. The child eventually left the hospital in good condition. She was heard from some months later, when she was attending school, and for the first time in her life was in good health.

Although the diagnosis of thrombocytopenic purpura was justified in this condition, it is to be noted that the blood platelets were not far from normal on repeated estimations, and not below what would be expected with a hæmoglobin of 30 per cent and a red cell count of 2,500,000. It is also to be noted that after operation the blood platelet count did not materially increase while the child was in the hospital, and the prolonged bleeding time was not reduced. From the fact that she is reported greatly improved, it is presumable that the blood at this time would show marked improvement.

THE PROBLEM OF COMPLETE SPLEEN REGENERATION[1]

By L. SCHOENBAUER and H. STERNBERG, Vienna

IN July 1924, the writers[2] published an experimental study on complete regeneration of the spleen. This study was based upon numerous animal experiments and observations over long periods of time up to 8 months. It led us to the conclusion that no regeneration of the spleen occurs in animals after its extirpation. The commonly accepted statement that such regeneration is possible we explained on the basis of the frequent occurrence of accessory spleens. These findings are neither accepted nor rejected by Theodor Koppanyi[3] in a recent article, but, on the other hand, he regards as erroneous our statement that small portions of spleen disintegrate when transplanted into the peritoneum of splenectomized dogs. He uses his own experiments, the studies of Ehrenpreis, and those of Marine and Manley, to prove his point.

The investigations of Koppanyi were conducted upon 7 white rats in which he transplanted spleen tissue. Necropsy 5 months later showed absence of splenic tissue in 3 rats, and atrophy of the spleen in 2 others. In the 2 remaining animals the transplanted spleen was normal, microscopically as well as macroscopically. Koppanyi agreed that we proved beyond a doubt the occurrence of accessory spleens in 20 per cent of white rats. It appears to us that in his 2 cases the question of accessory spleens was not successfully disproven.

With regard to the studies of Marine and Manley, and those of Ehrenpreis, quoted by Koppanyi, as opposed to our conclusion, we cannot refrain from pointing out some con-

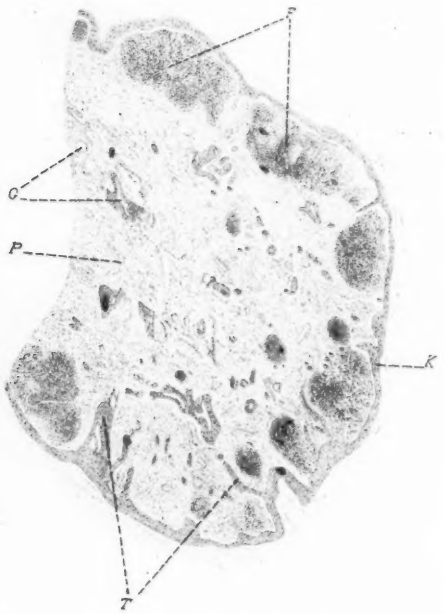

Fig. 1. Section of a nodule found in peritoneum 4½ months after transplantation of spleen parenchyma.

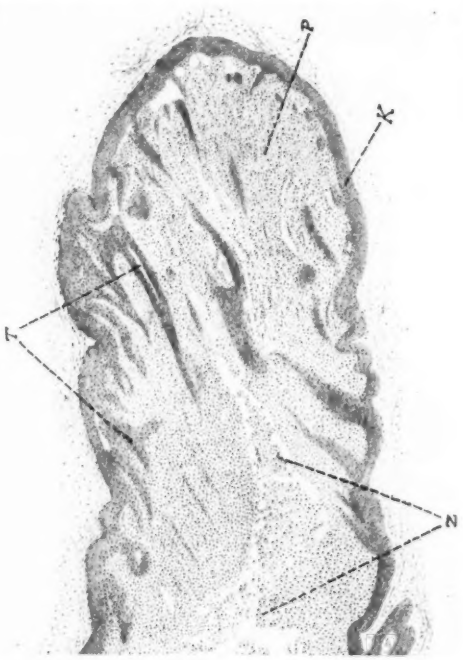

Fig. 2. Section of nodule from same dog, showing greater progress of necrosis.

[2] Wien. klin. Wchnschr., 1924, July 3, No. 27.
[3] J. Am. M. Ass., 1924, lxxxiii, No. 21.

[1] From the Embryological Institute and the I. Surgical Clinic in Vienna

tradiction in these papers. Marine and Manley found that in very young rabbits spleens could be successfully transplanted into the subcutaneous tissues, but they were unable to obtain the same results with older rabbits. Ehrenpreis, on the other hand, found that in adult urodela splenic transplantation was successful in about 40 per cent of cases. Such contradictory results hardly discredit our findings.

Since, for technical reasons, it was impossible to present certain pictures in our first publication, they are added here.

Figure 1 shows a section of a nodule found in the peritoneum 4½ months after transplantation of spleen parenchyma. The transplant is surrounded by a network of fatty tissue. The connective tissue capsule (*K*) of the transplanted spleen has not undergone any changes. In places trabeculæ (*T*) are seen to radiate from the capsule into the splenic pulp. Underneath the capsule closer groups of cells are to be recognized, which, under higher magnification, prove to be lymph follicles (*F*). The pulp (*P*) in the central portion of the transplant does not present a normal picture, the cells showing all evidence of disintegration. Some of the nuclei are only faintly stained, and in others the chromatin is irregularly clustered together; the walls of the vessels scattered through the pulp show hyaline degeneration in places. This picture corresponds approximately to the first stage of changes in splenic transplants described by Soper, in which stage the pulp first disintegrates.

Figure 2 shows a section of a nodule from the same animal (dog) in which the necrosis has made greater progress. The connective tissue (*K*) capsule is folded in places. The trabeculæ (*T*) of the nodule appear closer to each other because of the disappearance of the parenchyma. Only along the border areas can one demonstrate even an approximately normal splenic pulp. In the middle of the transplant one finds, in place of the pulp, necrotic material (*Z*), in which a few nuclear rests staining dark blue with hæmatoxylin may be recognized. The blood vessels which are still plainly recognizable in the nodules of the previous figures have here undergone complete disintegration. This figure shows sufficiently that the transplant is markedly shrunken, due to the deterioration of the pulp, and in its central portion completely necrosed.

Fig. 3. Five months after transplantation showing processes eventually leading to disappearance of transplant.

Figure 3, which is taken from a dog 2 months after transplantation, illustrates those processes which eventually lead to the disappearance of the transplant. The connective tissue (*K*) capsule is represented by a much folded membrane which stains deeply with eosin and is almost completely hyalinized. In place of the pulp a loosely clustered disintegration mass (*Z*), containing only occasional nuclei, is to be seen in the center of the nodule. Along the border of the section of the transplant the residual pulp areas are infiltrated with groups of cells (*L*) which have at one point broken through the connective-tissue capsule. The high power shows that these infiltrating groups are composed of leucocytes and newly formed fibroblasts and capillaries, and are to be regarded as granulation tissue.

In addition to these experiments, attempts at spleen transplantation in rats were made, and the findings reported recently by Breitner at the surgical congress of 1923, in Berlin. In normal animals splenic transplants were found to cause an increased accumulation of fat in the body and more rapid callus formation in fractured bones. Atrophy of the implanted portion of spleen was also a regular occurrence.

CYSTS OF THE SPLEEN

By Sir BERKELEY MOYNIHAN, K.C.M.G., C.B., Leeds, England

CYSTS of the spleen may be classified as true and false. True cysts possess a definite specific lining layer, epithelial, endothelial, or parasitic. False cysts are bounded by a zone which consists only of the tissue often condensed or changed, in which their cavity is formed.

The following table shows the varieties of these forms.

True	1. Angiectatic (being dilatation of normal vascular spaces)	In blood vessels	telangiectasis
		In lymph vessels	lymphangiectasis
	2. Neoplastic	Endothelial	hæmangioma
			lymphangioma
		Dermoid	
	3. Parasitic	Hydatid	
False	1. Traumatic	Serous cysts—multiple-superficial due to minute lacerations of the capsule.	
		Hæmorrhagic—large and solitary	
	2. Inflammatory	Acute—colliquative necrosis in infections.	
		Chronic—tuberculous.	
	3. Degenerative	Secondary liquefaction of infarcts.	

TRUE CYSTS

1. *Angiectatic.* An excellent example of a cyst resulting from the dilatation of pre-existing lymph spaces is recorded by Suchanek (22). The condition is also recognized by Coenen (3), who applied the term "lymphangiectasis" to the polycystic tumor, observed by him in a woman 30 years of age after the birth of her fourth child. The dilatation of the normal blood-containing spaces gives rise to the condition first described by Cohnheim (4) as "spleen varix." In his case death resulted from the bursting of the varix. The tumor is in truth a cavernous angioma, and was so recognized by Geipel (8) and by Stamm (21), who attributed it to an embryonic "rest." *Cavernous angioma* has been studied with special care by C. N. Dowd (6), who has recorded an interesting case in his own practice and has collected the records of 12 other examples. The tumors have sometimes an affinity with sarcoma: they are probably due to developmental error, or at least to the same cause that gives rise to the cutaneous and subcutaneous angiomata which are so common. When rupture occurs in a part of the tumor a large blood cyst may form. Other organs, the liver, the stomach, the lungs, have been implicated in the disease in 6 of the 13 recorded cases; and at times the growth elsewhere may be larger than that in the spleen. In Langhans' case (13) the tumor pulsated: secondary nodules were found in the liver. Splenectomy has been successfully performed in three cases.

2. The differentiation between the angiectatic and the neoplastic forms of tumor involving the blood-vascular or lymph-vascular structures is difficult or impossible, except perhaps in their earliest stages.

3. *Dermoid cysts of the spleen* are extremely rare. So far as I can discover only two cases are recorded. The first is related by Andral (1) who wrote:

"The spleen may give rise to far more complicated kinds of cysts. I have seen one which had fibroserous walls. The interior contained fibrofatty substance, almost greasy, in the center of which hairs were scattered about."

The second is recorded by Kummaris from the Institute of Surgical Anatomy and Operative Surgery, Athens (see Fowler, 7).

"The patient was a woman of 40 years. When 2 years of age she fell from a balcony apparently without bad effects. She had been married 14 years and had borne two children. For 5 years she had noticed an increase in size of the abdomen. At the same time varices and pain in the left leg developed after a slight disturbance of menstruation and periodic gastro-intestinal derangement. Upon examination there was found a tense cystic tumor in the lower abdomen which occupied the pelvis and extended to the navel. The pre-operative diagnosis was ovarian cyst. At operation no free fluid was found in the peritoneal cavity. The omentum covered a thick-walled cystic tumor which was adherent for the most part and situated in the pelvis. There were firm adhesions to the intestinal coils. The tumor, larger than a man's head, was delivered with difficulty. The

Fig. 1. Hydatid cyst of the spleen. From a case of splenectomy in which a part of the diaphragm was removed on account of dense adhesions. The large cyst was full of daughter cysts.

spleen was not in its normal situation. The uterus was three times its normal size and myomatous, adnexa normal. The growth was found to spring from a dislocated spleen. It was impossible to remove it on account of the firm adhesions. The cyst was punctured and emptied of a liter of peculiar fluid which consisted of a brick-red, thin substratum and a number of regular, round, white, shot-like little balls. A portion of the cyst wall was removed for diagnosis and the growth marsupialized. A large amount of hair was removed from the cystic cavity. The postoperative course was normal. Patient was discharged in 30 days with a fistula. Histologic appearance showed that the cyst wall was uniform, and consisted of connective tissue. Blood vessels were engorged, tissue showed some hyaline degeneration. There was considerable hæmorrhage. There were collections of hæmosiderin crystals. The interior of the cyst was smooth and without epithelial lining. The fluid contained blood corpuscles. The fat balls when crushed consisted of round fat droplets, which stained easily with Sudan III. There were no cholesterin crystals. Examination showed that the fat balls remained unchanged when placed in water heated to 100; but at 120° they broke up."

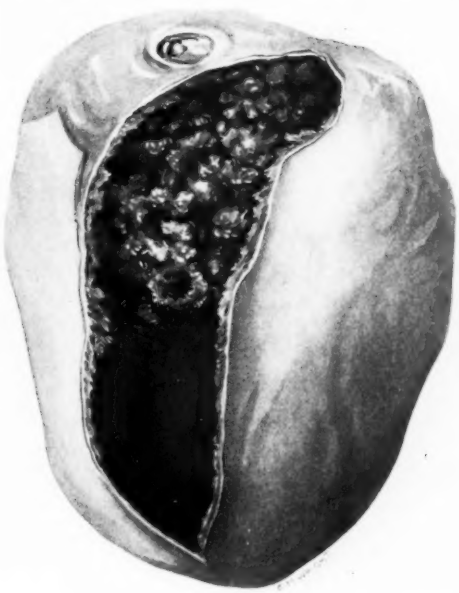

Fig. 2. Cyst of the spleen due to acute colliquative necrosis. From a man aged 26 who died of purpura hæmorrhagica.

Hydatid cyst of the spleen though generally found in company with similar parasitic cysts elsewhere in the body may exist alone (Gras, 10; Martin, 15; Dieulafoy, 5).

The cysts may begin in the body of the organ which expands to form a sort of capsule for them; they may begin in the periphery, and the spleen then appears as a mass adherent to the cyst wall with which it is in some degree incorporated; they may begin in the capsule of the spleen or outside it and remain attached to the spleen by a pedicle which is broad or narrow. The cysts, therefore, may be described as central, peripheral, and juxtasplenic. The spleen may be hypertrophied, or it may appear to be reduced in size in consequence of its partial incorporation in the wall of the cyst. As the cyst increases in size it may enlarge chiefly in an upward direction displacing the diaphragm or even perforating it, to gain access to the lung or to the pleural cavity. Or it may enlarge in a downward direction and occupy the greater part of the abdominal cavity. The "ascending" or "immobile" and

Fig. 3. Tuberculous cyst of the spleen with calcified walls; described as "the remains of an old tuberculous lesion." There was "extreme pulmonary fibrosis."

the "descending" or "mobile" types of cyst are described by Dieulafoy. In the former, the lower ribs may be pushed out, and the measurement of the left half of the chest then greatly exceeds that of the right. In the latter, a painless enlargement of the abdomen slowly develops, which in one case has been mistaken for pregnancy (Quénu et Duval, in Martin). The signs produced will, therefore, vary in different cases, and the symptoms will indicate either a thoracic or an abdominal distress. Pain, a sense of heaviness, respiratory distress, vomiting are all present in different cases; hæmoptysis has been observed: constipation has been attributed to the adhesion of the cyst to the colon. The cyst may adhere to the stomach and two cases of perforation into this organ are recorded (Gérin-Roze, in Martin, see above): it may burst into the colon and cause a spurious diarrhœa: it may leak into the general peritoneal cavity: or, becoming adherent to the skin, may discharge its

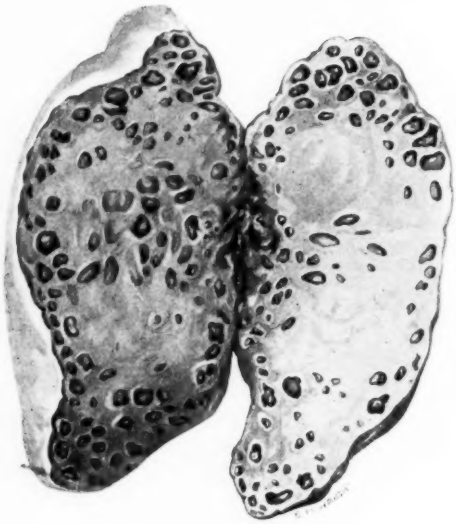

Fig. 4. Multiple tuberculous cysts of the spleen. From a monkey.

daughter cysts to the surface. In a few cases infection of the cyst may occur acutely and be attended by a high temperature or by rigors. Calcification of the smaller cysts appears to be not infrequent. It occurs only in the later stages, and its occurrence is an evidence of the latency of a cyst which has not declared its presence by any signs or symptoms that have attracted the attention of the patient.

A correct diagnosis will be based upon the symptoms and physical signs, the reaction of Weinberg, and the evidence afforded by a radiographic examination (see Morestin, 17). An "elongation" of the spleen, the separation of the two poles by a central mass, is said to be characteristic of echinococcus tumor. In neither of my own cases did I make an accurate diagnosis before operation.

TREATMENT

Splenectomy is not always necessary. If the cyst is central and expands the spleen, nothing else is possible. But if the cyst is peripheral or juxtasplenic, then marsupialization may be the wiser method. The adhesions so frequently found around the spleen make the occurrence of general peritoneal contamination very un-

likely, especially if formalin has been first injected into the cyst.

Removal of the spleen may present difficulties almost as great as those encountered in cases of splenic anæmia. This is especially true in the ascending type of tumor, when adhesions to the diaphragm may be exceedingly dense. In one of my cases I was compelled to remove a portion of the diaphragm with the tumor. Fortunately, it was not difficult to close the gap in the muscle: and the patient recovered easily and quickly.

Mills (16), in an admirable summary of the subject of hydatid cyst of the spleen in which he gives a list of all cases operated upon since the year 1900, writes:

"It is only to add that, while investigating the subject on the occasion of the recent visit to South America under the auspices of the Clinical Congress of the American College of Surgeons, I found that the majority of the leading surgeons in Argentina and Uruguay, and they are all experts in the matter of echinococcosis, were by no means wedded to splenectomy as a routine treatment for hydatid cyst of the spleen. On the contrary, they reserve this procedure for cases of multiple cysts of the spleen, or those in which the spleen is practically destroyed by one enormous clean cyst. Smaller clean cysts they preferred to treat by the closed method, and suppurating cysts by marsupialization."

There are in all, according to Mills, 56 recorded cases of splenectomy with a mortality of 14.3 per cent. Both my own cases recovered.

FALSE CYSTS

1. *Traumatic cysts* are of two kinds. There are multiple small cysts on the surface of the spleen in not a few cases which are examined either during operations for other diseases, or upon the postmortem table. Schmidt (20), who states that 35 or 40 cases were seen yearly in the postmortem room at Strasburg, attributed the origin of the cysts to the rupture of the spleen capsule followed by a hernia of splenic tissue which undergoes degeneration. Renggli (19) ascribed them to the inclusion of peritoneal endothelium within the splenic capsule. They are of no clinical importance.

The larger hæmorrhagic cysts are due to injuries which just fail to be accompanied by a laceration of the surface of the organ also. Because of an injury either direct or indirect, the vessels in the interior of the spleen are torn and a gross hæmorrhage occurs. The usual changes take place if the patient survives, and in due course a cyst with deeply blood-stained contents, or more rarely with pale yellow contents, is formed. Heurteaux (12) records a case of hæmorrhagic cyst containing 10 liters of fluid. (See also Hamilton and Boyer, 11, and Lombard and Duboucher, 14.)

2. *Inflammatory cysts.* A good example of the colliquative process that results in the formation of a large cavity in the interior of the gland is shown in Figure 2. The spleen was softened and the lower end occupied by a cyst containing several ounces of blood-stained purulent fluid. The cavity walls were lined with shaggy, altered splenic tissue.

An excellent case of that chronic form of tuberculous disease which leads to the development of a solitary cyst is shown in Figure 3 from the Leeds Museum. The patient was a man aged 54 with extreme pulmonary fibrosis. At the upper end of the spleen is a large cyst with calcified walls. It is about ¾ inch in diameter. An interesting example of tuberculous cyst in which the spleen was successfully removed is recorded by Peck (18). Rarely the cysts are multiple.

3. *Degenerative cysts.* Infarcts of the spleen sometimes undergo softening with the result that one or more cysts are found containing turbid serum or altered blood with cholesterin crystals in it. An excellent example of cyst of the spleen almost certainly due to an infarct following upon the blocking of the splenic artery is recorded by Gosselin (9).

Bircher (2) gives the following results of operative treatment in cases of splenic cysts of all forms: In a total of 33 cases there were 6 cases of puncture with 2 deaths; 9 cases of incision and drainage with 1 death (due to infection); 4 cases of resection with 1 death (due to obstruction); 15 cases of splenectomy with no death.

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JOINT TRANSPLANTATIONS AND ARTHROPLASTY

By Professor ERICH LEXER, Freiburg (Baden), Germany
Translated by Frank H'Doubler, M.D., Ph.D.

THE operations which are necessary to re-establish joint function — weight bearing and motion — vary fundamentally, depending upon whether the problem is one of repairing defects of the joint region or of doing away with ankylosis. Joint transplantation is essential in repairing joint defects, and further plays a rôle in the treatment of ankylosis. We classify under the name "arthroplasty" all operations which are designed to establish movement of joints. In Surgery, Gynecology and Obstetrics in 1908, I reported my first cases of joint transplantation, and in 1914 in New York, at the International Surgical Congress, I took occasion in my paper on free transplantations to describe my experience with transplants of free layers of fat tissue in joint mobilization. In spite of this, in the American literature, this latter experiment concerning which I reported, first in 1910 and then in detail in 1916 in the *Deutsche Zeitschrift fuer Chirurgie* and in 1917 in my book *Free Transplantations*[1] has been entirely overlooked. This I have understood especially from the works of Kanavel and MacAusland.

JOINT TRANSPLANTATIONS

Through clinical research on the value of autoplastic and homoplastic large joint transplantations, I first conceived the idea in 1907 of repairing, by means of a transplant which included the joint surface of the tibia, an operative defect of the tibia which extended into the knee joint. At the same time in another case of severe bony knee-joint ankylosis, the result of suppuration following resection, I attempted to repair the defect by using the two joint portions of the femur and tibia. In both cases the transplants came from freshly amputated limbs. I named the first operation the half-joint transplantation and the second the complete.

Since over 16 years have gone by during which I have accumulated considerable experience by virtue of the large amount of clinical material which has been at my disposal, I hold myself duty bound to report the end-results of these operations—operations which have given good results in animal research. We dare not, however, practice such operations on man without further consideration; for in experimental work the operations are generally undertaken on small animals and the technique is more difficult than in operations on man, and, secondly, it is impossible to care for the research animal after operation in a way necessary for securing functional healing of the transplant. So that it is the result secured in man that decides the value of the operation. Also one must not, as has happened, allow himself to pass judgment in unsuccessful cases on the basis of microscopic findings. The greatest impediment to the transplant is the effusion of blood which may surround the implanted tissue and hinder the germinal tissue of the bed, the implanted specific, as well as the usual original connective tissue, from growing into the transplant with new vessels which guarantee its nourishment and thereby its reconstruction. The blood

[1] Neue deutsche Chirurgie, Band 26a.

effusion becomes organized with germinal connective tissue producing a callus, which encapsulates the transplant. The transplant then degenerates; its specific cells are not in position to care for its vital metabolism. Each transplant needs exceptionally good contact with its bed to secure nourishment and this is possible only when the bed is free from blood clots, and no callus forms from the connective tissue. When bone and joint transplants are separated from their beds by blood or tough encapsulations no judgment can be formed as to the behavior of transplant tissue as such. In the cases of Kuettner, Borst, Enderlen, and others, one finds in the pathological specimens just such poor union with the neighboring tissue. In these cases the extensive necrosis of the periosteum, the at best incomplete restoration of bone substance, the incomplete union with the bone stumps are not to be wondered at. Naturally a transplant degenerates if it is bathed with pus from operative infection.

My first 2 cases of half and complete joint transplantation were operated on November 3, 1907, and were first reported March 2, 1908. Soon thereafter, on May 9, 1908, Bauchman reported 2 cases of bony elbow joint ankylosis in which the entire metatarsophalangeal joint, resected with closed capsule, was autoplastically implanted with good results; and Judet reported his animal experiments extending from June, 1906, to May, 1908, in which he tried out and established the behavior of joint sections with and without synovial membrane, and of entire joints with and without capsule transplanted into soft tissue, and further the behavior of uncovered joint portions inside of the capsule which remained in the repaired defect. This research work was reported on July 6, 1906, before the Paris Academy of Science, but I had not noticed this (as Judet himself says) hidden reference. Later, Dastre at sessions on January 27 and March 6, 1908, reported these (see Judet's *Angaben*, 1909). The knowledge of the results of Judet's animal research would have necessarily restrained me from carrying out in men entire joint transplantation without the capsule. In 1909, Judet worked out on the cadaver, and published a description of a procedure for the removal of a closed knee joint.

From all this it is seen that the idea of joint transplantation was conceived and worked out simultaneously and independently in different places.

One may consider reimplantation of joint cartilage as the forerunner of joint transplantation. This has been undertaken by different surgeons in cases of luxation fractures and separations: in Germany by Franz Koenig, in France by Tuffier (1901). Tuffier, who also reimplanted in cases of old dislocations the removed joint cartilage (1910), with this so-called chondroplastic resection, came close to doing actual joint transplantation, but he did not undertake the wider step until 1911, when he restored homoplastically with joint portions from amputated limbs two ankylosed elbow joints after resection. The claim of the French literature that Tuffier discovered joint transplantation is therefore not correct.

Another forerunner is the ankylosis operation of Weglowski, 1907. He inserted plates of rib cartilage between the resected surfaces. In addition, he undertook a similar study, but was not able to give the after-treatment.

Tietze in 1900 after resecting the lower end of the radius autoplastically implanted the main phalanx of the big toe so that its base completed the new joint. The main interest in his case at that time centered around the behavior of the bone. The transplantation of the joint surface was not emphasized and nothing was reported concerning its behavior.

Experimentally the question of transplantability of cartilage-covered joint portions has been treated in various ways. Though the first work of the kind by Judet is so thorough, it still leaves many questions open and takes little cognizance of the demands of practical surgery. In conjunction with his animal research Judet contributed later, after his operation was made known, a procedure for the removal of the knee joint which he worked out on the cadaver. The animal experiments of Judet were concerned essentially with the source of nourishment of the implanted joint cartilage. Isolated removed portions of these were reimplanted into the joint space. The experiments succeeded in

maintaining the cartilage; there was success even in reimplanting the entire femoral joint surface into the capsule which had been left, and the reimplanting of the entire femoral and tibial joint surfaces, together with meniscus and crucial ligaments into the capsule which was thereupon closed. On the other hand homoplastic transplants of this kind into the capsule of the recipient were unsuccessful because of suppuration. Other homoplastic experiments were tried out only with transplants under the skin. At this point the important question was touched upon whether, for the preservation of the joint cartilage, it is unconditionally necessary to transplant with it the joint synovial membrane. This question was affirmed by Judet. This is the most important point of his research. When he transplanted a portion of joint cartilage surrounded by a layer of synovial membrane it was well maintained after 2 months, and the cartilage had a smooth surface, while in control experiments a similar piece without synovial membrane showed marked breaking up.

The most important experiment was the one in which an entire closed knee joint of a rabbit (which is everywhere surrounded by capsule) was transplanted under the skin with a control experiment upon the same animal with transplantation of a knee joint without capsule. After 63 days the naked, transplanted joint was surrounded by fibrous tissue that filled the joint space. The superficial cartilage layer had degenerated and was replaced by connective tissue. The middle layer showed degeneration. On the other hand, the joint which was transplanted with its capsule was found inside of its capsule which was adherent to its bed, in an astonishingly complete state of preservation without sign of degeneration in the cartilage cells, with complete nourishment of the synovial membrane, fat lobules, and meniscus, and with free mobility. Judet came to the conclusion that the synovial membrane is the most important and specific source of nourishment for the joint cartilage and that therefore a good result from joint cartilage transplantation is to be expected only when the transplant either goes into a closed joint cavity, or is transplanted surrounded by a joint capsule, which is simultaneously removed with it. There is no question that the synovial membrane furnishes the physiological nourishing fluid for the joint cartilage.

But the animal experiments undertaken by other authors, namely those of Axhausen, have shown that joint cartilage transplanted into soft tissue is also in a position to survive, and that the nourishing fluid from the soft tissue bed is in a position to insure preservation and regeneration of the cartilage cells. It is important that these results were obtained not only on animals but also on man.

Ostrowski had the good fortune in 1922 successfully and indeed homoplastically to transplant joint cartilage into soft parts in man just as Axhausen did. He obtained the pieces of cartilage from arthrodesis operations on crippled limbs. The transplants were placed subcutaneously or intramuscularly. After a preliminary degeneration in the first 8 weeks, there occurred later a preponderance of regeneration.

Without going further into the subject of animal research, I wish to establish the fact that the best chances of preservation of a piece of joint cartilage in autoplastic as well as homoplastic transplantation are obtained when the transplanted joint cartilage has a bed lined with synovial membrane. But certainly the cartilage may survive when not surrounded by synovial membrane. This is exceptionally important in entire transplantation, i.e., transplantation of two joint surfaces. (See Entire Joint Transplantation.)

THE HALF-JOINT TRANSPLANTATION

The first case of half-joint transplantation operated upon by me in 1907 was a cystic sarcoma in the upper third of the tibia. The transplant, which was taken from a freshly amputated leg, took exceptionally well with very good motion and capacity for weight bearing. In spite of the fact that the joint surfaces did not articulate exactly, since the transplant had to be taken from a leg which did not correspond as to right and left, only at the beginning was there noticed, on bearing weight, a slight looseness. In spite of the best clinical results amputation had to be per-

Fig. 1. Autoplastic substitution of the lower end of the radius with the end of the same bone after 4 months.

formed 1 year and 5 months later because of religious considerations of the patient's. I showed this interesting specimen in 1910 at the German Surgical Congress, and have described it in detail in my book entitled *Free Transplantations*. The specimen showed complete union with the diaphysis; the spongy part of the epiphysis was well restored and nourished in the periphery, it was dry and necrotic only in the middle, which probably was due to the fact that out of fear of toxic influence of the degenerating marrow, I replaced this latter with iodoform paste and thereby shut off the inner part of the transplant from its nourishment. The joint surfaces of the tibia were grown fast to the menisci of the bed, the crucial ligaments were united with the tibia, the capsular attachments were well united, and there were no adhesions in the joint cavity. The joint cartilage was everywhere well maintained, indeed, regenerated. Only opposite the condyles were there pressure lesions.

Also in a second case operated upon by me in 1910, in which the entire lower third of the femur was resected on account of sarcoma and homoplastically replaced from an amputated leg, I obtained the specimen later through amputation on account of recurrence after 5 months. In this case also the joint cartilage, with even the furrows on the condyles, was well maintained, while the capsule and the crucial ligaments had healed in good shape. The substance, cells, and nuclei of the joint cartilage showed almost everywhere normal

Fig. 2. Autoplastic substitution of the upper end of the humerus with the upper end of the fibula after 3 months.

appearance. However, the subchondral spongy structure was necrotic and the deeper layers of cartilage were spread out in star-like patterns and in a state of cellular regeneration. At the edge of the specimen, vessel bearing connective tissue was forcing its way into the spongy spaces under the cartilage. At a place on the edge probably injured by trauma, superimposed upon the cartilage, connective tissue was forcing its way out from the synovial attachment as a tender membrane. In this vicinity were large nests of cartilage cells. The competition between the ingrowing connective tissue and the cellular regeneration of cartilage around the injured point is not apparent in the specimen. The cartilage was undoubtedly injured in an attempt at walking allowed 3 months after the operation. This injury evidently did not interfere with function

as the 12 year old child could soon walk and run.

The specimen teaches that in half-joint transplantations the joint cartilage is maintained and nourished from the joint side, regenerates itself in spite of the complete necrosis of the underlying spongiosa; and further, that early function deters cartilage regeneration. Clinically the half-joint transplantation whether autoplastic or homoplastic has proved its worth and will remain a recognized procedure of surgery. I shall indicate the most important possibilities of the operation in so far as they have given me and other authors the best results.

AUTOPLASTIC HALF-JOINT TRANSPLANTATION

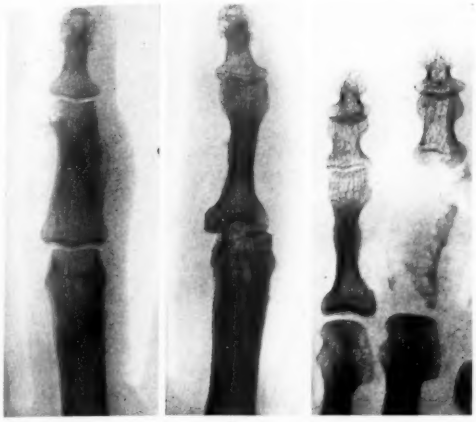
The autoplastic half-joint transplantation only in limited cases can fulfill its task, namely, to compensate for a portion of a joint, as a rule, the head of the joint, simultaneously with a corresponding portion of the bone. In a short bone, it is possible to retain both joint surfaces. It is absolutely unnecessary to retain the capsule on the transplant if the capsule in the bed has been preserved and can be fastened outside of the joint surfaces. However, when the capsule is not present in the bed it is not wise, on account of furnishing nourishment to the joint cartilage, to have the transplant united with its own capsule. A capsule-like covering develops spontaneously and the fear that fibrous ankylosis may develop from ingrowing connective tissue has not been clinically justified, and naturally the autoplastic operation is to be chosen only when a corresponding joint head can be removed without damage.

The source of material is limited usually to the phalanges of the toes, to the fourth metatarsal, and to the upper ends of the fibula and radius.

The first autoplastic phalangeal transplantation was described by Heinrich Wolfe in 1909. The tuberculous proximal phalanx of the fourth finger had been removed together with the destroyed capsule of the proximal joint and was replaced by the proximal phalanx of the second toe together with its two joint ends without the capsular covering. One year and 8 months later the follow-up examination showed an excellent function in the hand and finger—an excellent result similar to that obtained in my first homoplastic experiment of this kind. The important point in these cases is that the simultaneous transplanting of the joint capsule is unnecessary as no impairment of function results when it is not used.

The literature shows that the autoplastic replacement of phalanges has become universally established (v. Stubenrauch, 1909; Goebel, 1911; Leonte, 1911; Kuettner, 1912; Sievers, 1913). Kuettner used the proximal phalanx of a hammer toe to replace a portion of the fifth metacarpal removed because of an enchondroma. Oelecker implanted the middle part of an amputated finger to replace in the other hand the proximal segment of the thumb which had formerly been removed because of tuberculosis. My assistant, Rehn, used the small head of the radius with an adjacent portion of bone for replacing the lower epiphysis of the same bone (Fig. 1). Of significance is Bardenheur's (1909) use of the fourth metatarsal together with its head for replacing the joint process of the lower jaw, an operation which was later taken up by Klapp. In 1910 Rovsing used for the first time the upper end of the fibula for replacing the upper two-thirds of the humerus. I have done this four times (Fig. 2). In all cases there was excellent active function. In a similar manner 2 cases were operated upon by Borelius in 1913. Van Saar replaced the lower radial epiphysis with the head of the fibula (Fig. 3, a, b, c).

Reimplantation is a subgroup of autoplastic transplantations. Experiments show that a section of joint planted back into its own bed is in better condition for "taking" than one transplanted from another place; as it always fits well, the function is everywhere uniform and in no place increased or injurious. This is of greatest value in reconstruction with living tissue, but the conditions at the reimplantation operation are such that the section which is reimplanted is seldom in as good condition as the usual autoplastic section, for after joint and dislocation fractures, not only the bony portions but also the joint cartilage show severe traumatic injuries. In



a. *b.* *c.*

Fig. 3. a, Sarcoma of the middle phalanx of the third finger; b, 10 months after the substitution with the proximal phalanx of the second toe; c, 10 months after the substitution of the removed phalanx with costal cartilage.

older cases the cartilage is atrophic and grown fast with the surrounding scar tissue originating in the torn blood-infiltrated soft parts. Besides this the possibility of nourishment is bad on account of the injured and cicatricial bed. According to conditions, we are concerned with planting back the joint cartilage either alone or together with a variable sized portion of bone, and sometimes with fresh, sometimes old dislocation fractures and dislocations. Tuffier named the procedure "chondroplasty" without, however, as the name would suggest, limiting the operation to reimplantation of the cartilage alone. His procedure corresponds for the most part to that of Jacob, 1912, who hollowed out the resected humeral head in cases of old shoulder dislocations by removing the spongiosum and planted the cartilaginous, bony cap on the rounded off stump.

A second procedure is that of Klapp, 1909, for old shoulder joint dislocations. It consists in reimplanting the joint head, which has been freed from adhesions, on the humeral shaft, which has been freshened by sawing. Klapp valued this shortening of the diaphysis because it gave diastasis favorable for motion. I have reimplanted a portion of a broken off or dislocated joint on the upper and lower end of the humerus without shortening the shaft.

Fig. 4. Four months after homoplastic substitution of the upper half of the humerus with the lower half of the femur from an amputated leg.

HOMOPLASTIC TRANSPLANTATION OF JOINTS

It is necessary to distinguish between the fresh homoplastic transplant and the homoplastic transplant from the fresh cadaver. As regards the first, only those amputated limbs are considered suitable which are undoubtedly free of infections or tumors. The material is limited to cases of new wounds requiring amputation, and to cases with dry angiosclerotic necrosis (never with gangrene or diabetes). Further, cases of infantile paralysis can be used, if amputation is desired because of complete lack of function and retarded growth. Finally, in all cases in which severe wounds with paralysis, muscle destruction, etc., necessitate amputation, the joint material is usable only when the joint cartilage is in good condition. Patients with atrophic joint cartilage or old patients whose joint cartilage has changed through arthritis deformans are not favorable subjects. The joint cartilage of paralyzed limbs and the metaphysis and epiphysis affected with probably malacia

spongiosa are more slowly and less completely restored. The preparation of the bed requires restoration of the most favorable conditions for nourishment of the transplant. No fatty tissue must remain in the wound cavity. Injury from wound retractors is to be avoided. In a dislocation of the end of the bone to be resected the tissue of the bed must not be crushed or torn. In removing sections of joints on account of tumors, all this may happen. Favorable relations are more difficult to re-establish after old traumatic and inflammatory disturbances. In such cases scar tissue which does not offer the transplant good nourishment can easily be left. After tuberculosis and suppuration the latent tissue infection and sensitiveness of the tissue to traumatic irritation are additional factors. The joint capsule may be left in the bed only when it is proven to be completely normal.

I consider the immediate transfer, while the tissue is of body temperature, to be an important point. Then the conditions for nourishment are better than after the transplant has been preserved in sterile fluid. I always proceed so that during the preparation of the bed the case designated for amputation is prepared. After completely ligating the vessels in the bed, and arresting the last oozing from the tissue with gauze dipped in warm Ringer's solution, I remove the transplant bloodlessly and imbed it immediately, while the amputation is done by an assistant. In 2 cases I received amputated limbs from other institutions several hours after operation and used them with good result.

In the course of time I have in almost all large joint operations carried out the half-joint transplantation as in my first case. The operations were done usually to repair operative defects after resection of a sarcoma which involved the immediate region of the joint cartilage, as in the upper tibia; in the femur at both ends; in the humerus mostly at the upper end; in the radius and ulna at the lower end; and further metacarpal and metatarsal bones and phalanges. It was not always possible to obtain identical joint sections, for instance to replace resections of the upper tibia and of the lower femur, since amputation material usually comes from the leg. Thus I have had to replace the upper half of the humerus from the lower half of the femur; shaping the condyle bearing section to correspond to the head of the humerus (Fig. 4).

Frequently the upper half of the fibula had to be used for replacing the humerus. I also replaced the lower end of the radius from the lower end of the tibia, and the lower half of the ulna from the femur. I have not replaced the lower end of the tibia.

The case reported 3 years after the operation illustrated in Figure 5, a, b, c, showed that the motion and function had been maintained in spite of work. This 20-year old patient had to walk daily 6 kilometers to and from her work in the factory. She could jump and run like a healthy person and also could go upstairs without showing on which side the operation had been done. (Presented at Surgical Congress, 1910.)

Among the cases which I have completely described in my book on transplantations, there is only one single operative failure, and in this case the clinical treatment cannot be blamed for this since the patient left the clinic before conclusion of the treatment. The upper third of the femur had been replaced homoplastically after removal for osteitis fibrosa cystica with spontaneous fracture and bending of the entire trochanter region. A small fistula had formed and had not been treated. Following an erysipelas marked suppuration set in, and the healed-in transplant became sequestrated and was resorbed a half year after the operation. In fastening a large piece of bone with its joint head, bolts were used for the most part, made from a homoplastic portion of the diaphysis, usually of the fibula. It is worth while to emphasize that some periosteum should be left on the diaphysis stump of the recipient so that the points of union of the two ends of the diaphysis are covered. Thus is guaranteed a rapid callous union.

If the capsule in the bed is in good condition, its edges are fastened on the other side of the joint cartilage to the periosteum of the transplant. The soft parts must be sewed around the transplant with the greatest exactness so that they will be made to fit snugly throughout.

a. *b.* *c.*

Fig. 5. a, Homoplastic substitution of the upper third of the tibia from an amputated leg; 1 year after the transplantation; b, active flexion after 1 year; c, active extension after 1 year.

A plaster cast is applied after the operation and is worn for 4 weeks. The sutured skin is covered with silver foil, after the method of Halsted, so that it is unnecessary to put windows in the cast and to remove the skin stitches before taking off the entire cast, for under the silver foil not the slightest stitch inflammation will occur.

After removal of the cast active motion is cautiously begun. Not until 2 weeks later is passive motion with apparatus started. That the musculature must be simultaneously strengthened by massage and electricity is self-evident.

A difficult point in the after-treatment is when to allow weight bearing. It is certain that in my first cases, I allowed weight bearing much too early. As long as the cartilage is not sufficiently nourished and is not regenerated in places where it has degenerated, it is just as powerless to resist pressure and rubbing as is the joint cartilage of the aged and of patients with neuropathic joint diseases. Pressure ulcers and furrows develop. According to my experience, motion with weight should not be allowed until at least 3 months after the operation. Therefore a weight diverting apparatus is often necessary.

A still more difficult problem than the nourishment of the joint cartilage is the nourishment of the subchondral spongiosa. In well healed transplants removed because of tumor recurrence I found after 1 year and 5 months the spongiosa not entirely replaced; after 5 months it was almost entirely dead with the exception of a small zone near the attachment of the capsule. This is not to be wondered at for the blood vessels must grow in through the periosteum and cortex of the transplant by using the canals present in the cortex. The transplant becomes vascularized from the marrow tissue of the diaphyseal stump; but in cases in which large sections of bone are involved the distance from the marrow to the joint cartilage is so long that the subchondral spongiosa is vascularized almost exclusively from the perforating vessels. Therefore there is no special disadvantage in fastening the transplant to the diaphysis by means of a bolt. Cognizance of this is very important in the after-treatment. Today I would use a weight diverting apparatus on a leg at least 2 years.

In joints of the arm the harmful influence of pressure on the joint surface plays no rôle. Pressure is produced to a slight degree by

Fig. 6. Transplantation of a knee joint without capsule in a case in which the joint is lacking.

muscular activity. The dead spongy trabeculæ which lie deep under the joint cartilage are endangered through pressure, especially during the time when the first vascularization sets in with resorbing influence and when the living transformation, because of lack of sufficient osteoplasts of the bone marrow, proceeds very slowly and imperfectly. All this plays a rôle, especially in the total joint transplantation.

I have not noticed in half-joint transplantations secondary joint changes similar to those seen in total joint transplantation and in arthritis deformans, nor have I seen irritation of the joint capsule as might well be possible because of the foreign cartilage of the joint transplant. Hydrops occurred only once in the first case in a knee joint, after the upper third of the tibia had been replaced. There was a special reason for this as the specimen showed. In this case I had filled the marrow cavity with iodoform paste with the result that a large area of the spongiosa in the center of the dry necrotic portion had broken down. In the surrounding tissue where the spongiosa trabeculæ showed living transformation and the marrow cavity was filled with fibrous tissue rich in vessels, there was a wall of granulating tissue which at one place showed union with the joint space because of a pressure ulcer of the joint cartilage.

My experience, and that of others to date, with the half-joint transplantation, justifies the conclusion that this operation with either autoplastic or homoplastic transplants offers the greatest hope of re-establishing complete function even in cases with the greatest operative defects; and therefore has taken the place of the former mutilating operations. To be sure one must consider the long duration of the regeneration process but the advantage is so great that the disadvantages of long treatment with wearing of apparatus do not count.

Kuettner has used homoplastic material from a fresh cadaver in various ways since I gave it up because of failure. Failure in my cases was due to infection, in spite of the fact that the condition of the cadaver was beyond question; but while the graft was taken soon after death it had to be removed in a morgue where there are all possible sources of infection. The graft should be removed immediately after death in an aseptic operating room, and I was able to do this in later cases of entire joint transplantations. In cases of sterile healing, cadaver material also has disadvantages. The specimens described to date of transplants of cadaver joint sections and two cases of mine plainly show that this material is apt to cause a strong irritation of the connective tissue of the bed; it leads to a scar-like encapsulation of the entire dead transplant (compare the cases of Kuettner and Enderlen) rather than to a living replacement of the transplant. Through this reaction of connective tissue callus, the joint motion may also be endangered. (Specimens of Enderlen and M. B. Schmidt.)

TRANSPLANTATION OF ENTIRE JOINT

In my first clinical attempt at transplantation of an entire knee joint, I did not use the capsule. Bauchman, however, in his two autoplastic cases, transplanted the joint together with its closed capsule. I was guided by the thought that as the transplant consisted of the two joint surfaces and was surrounded by its own capsule it had a poor chance for nourishment, because I believe the capsule would obstruct the fluid of the bed which alone nourishes the transplant until vessels have grown in. Nourishment of the joint cartilage may take place only when vessel bearing germinal tissue of the bed has grown into the capsule and when thereupon in favorable cases, synovial membrane is formed from the specific cells of the capsule. In the closed capsule the transplant is thus

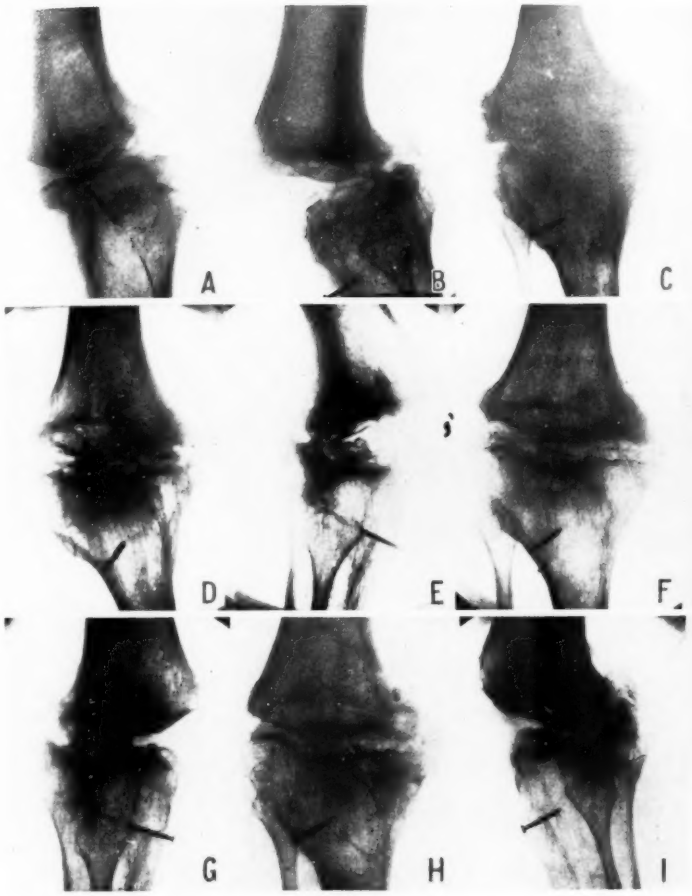


Fig. 7.

Fig. 8.

Fig. 7. Homoplastic knee joint transplantation; a, after ½ year; b, after 1 year and 4 months; c, after 1 year and 7 months; d and e, after 3 years and 9 months; f and g, after 5 years and 9 months; h and i, after 10 years.

Fig. 8. Case shown in Figure 7 after 5 years.

dependent entirely in the beginning on the nourishment from the side of the bone stumps to which it is fastened. This point is important. The wider the contact surface on the bone stumps and the thinner the transplanted joint portions, the more quickly will the subchondral spongiosa become vascularized from the bone stump. Frequently the mistake is made, particularly in animal experiments, of disturbing the channels of nourishment as may happen if bolts or wedges are used in producing union.

Joint transplants without the capsule are in the outer parts, in connection with the nourishing bed. From the beginning I considered this to be especially important since the two joint surfaces lying opposite each other are dependent on the nutrient fluid of the bed. The capsule undoubtedly would form a protective tissue, but clinically this is of no value when suitable functional aftertreatment is instituted; it has been shown in animal experiments that the presence of the capsule cannot with certainty prevent connective tissue ingrowth into the joint space.

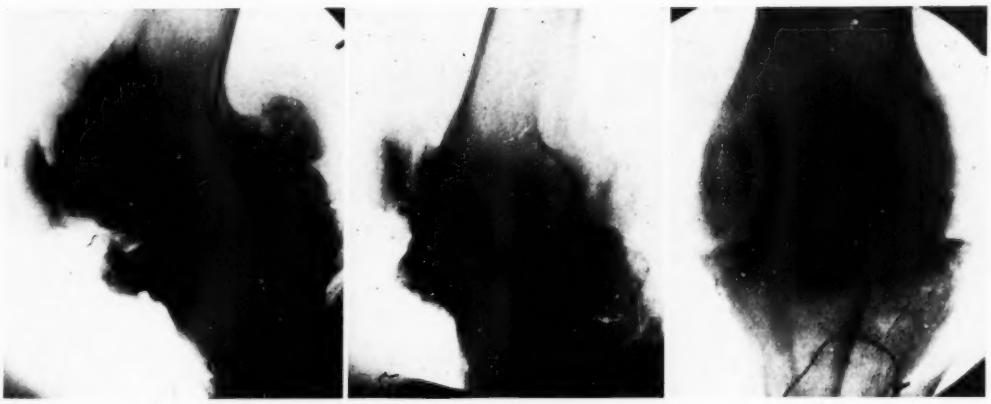
At this point the experiments of Obata and Minoura with Borst should be mentioned. It was always shown, however, that when the joint space was destroyed by ingrowing connective tissue the entire capsule together with

Fig. 9. Homoplastic knee joint transplantation on the right side. Motion picture taken after 6 months.

its villi was replaced by scar tissue. I do not believe that the transplantation is the cause of the capsular portion of the transplant becoming degenerated. I am inclined to believe that blood effusion hindered the nourishment of the capsule and that consequently there occurred connective tissue organization. Thus there are no conclusions to be drawn from this experiment. On the contrary, when Dalla Vedova transplanted the entire joint without the capsule in animal experiments single sections showed much better maintenance even in the presence of secondary changes through resorption and proliferation. This is all the more noteworthy, since in these experiments very frequently the nourishment from the bone stump was injured through the wedging in of the transplant.

In my opinion I do not believe that the question as to whether it is better to trans-

a. *b.* *c.*



d. *e.* *f.*

Fig. 10. Homoplastic knee joint transplantation. Same case as in Fig. 9; a and b, after 3 weeks; c, after 1 year; d, after 3 years; e and f, after 6 years.

plant an entire joint with or without its capsule is answered by experiments on animals. I transplanted an entire knee joint together with its capsule in one case, a child. I obtained the material at an arthrodesis operation. After good healing, motion was established, but after 3 months a fistula occurred, and when I opened the joint I found the necrotic remains of the capsule. The capsule had not received nourishment and had degenerated. To prove that this operation is a success in man, the capsule would have to heal in. So far as I know such a case has not been reported.

To me it is improbable that it could succeed, for success would presuppose an ideal preparation of the bed for the transplant so that the wound surfaces everywhere would fit exactly against the capsule enclosing the joint portions. Such an exact preparation of the bed is not possible either in resection because of tumor or above all in resection for ankylosis. It also happens that in the joint portion, the wall of the bed itself is badly

Fig. 11, *a*. Fig. 11, *b*.

Fig. 11. Homoplastic knee joint transplantation; a, after 6 months; b, after 2 years; c, after 8 years.

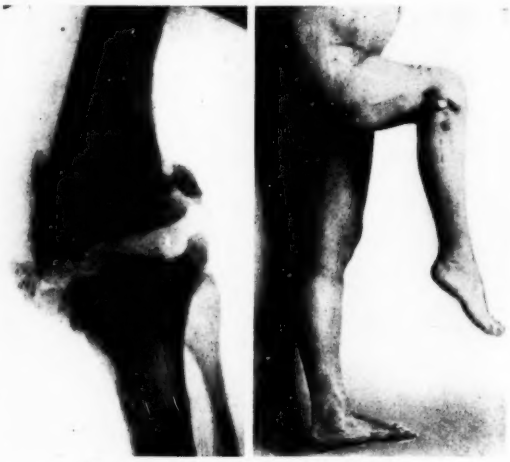


Fig. 11, *c*. Fig. 12.

Fig. 12. Homoplastic knee joint transplantation after 12 years. Same case as in Figure 11.

nourished in different portions, especially where it is formed by broad tendons. Therefore, I do not believe that the entire joint enclosed in its capsule can be successfully transplanted.

After a thorough examination of the reports to date of animal research by Judet, Dalla Vedova, Obata, Wrede, and others, I am of the opinion that the results argue neither for nor against the simultaneous transplantation of the joint capsule. In the difficulties of animal experimentation is to be found an explanation of the varying results and controversies. Dalla Vedova and my assistant, Wrede, obtained better results without capsule transplantation than with closed joints, and relative to the latter (closed joints), Judet demonstrated that only in cases of subcutaneous transplantation were all separate parts of the transplant maintained; while the experiments of Obata and Minoura are not conclusive because of scar tissue formation. Judet did not undertake transplantation into joint defects, and this is of especial significance because Baumgarten falsely asserted that I had used Judet's technique on man. On the contrary Judet's assertion that only joints covered with capsule will take, and that the ones without capsule are resorbed, surely would have held me back from my first attempt. For the first attempts at entire joint transplantation I chose a case with very severe ankyloses with destruction of the soft tissue through suppuration. Although the operation thus was similar to that used for mobilization of a stiffened joint, in contemplating the results, one must consider that today we would view such cases as unsuitable even for ordinary arthroplasty.

When I first undertook entire joint transplantation, there was not a single safe method of making a weight bearing joint movable. Helferichs' attempts at muscle interposition in the hip, and Murphy's first attempts with pedicled fat fascial flaps were known indeed, but Hoffa had reported that these had given no satisfactory results in weight bearing joints. With the idea in mind that by transplanting two articulating joint surfaces, I not only transplanted the physiological tissue, but also gave the joint surfaces normal form for support in weight bearing, I decided to try first entire joint transplantation on a case of ankylosis of the knee joint. Although the results of this operation are described in the technique of arthroplasty illustrated in the second part of this paper, I will report the changes observed in joints so operated upon.

Naturally only small joints can be removed and transplanted homoplastically. According

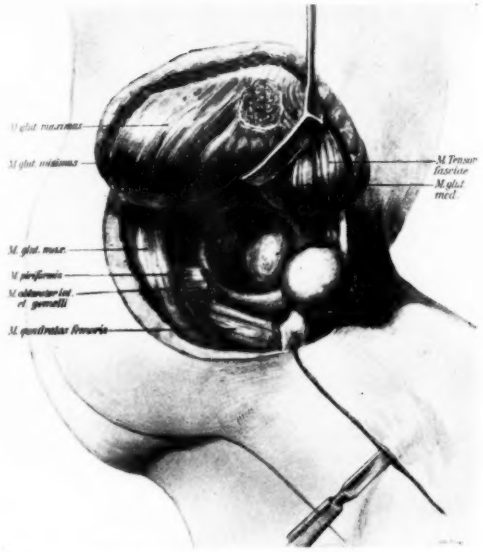


Fig. 13. Exposure of the hip joint for arthroplasty. The musculus piriformis and the musculus obturator internus need be divided only exceptionally. Incision for the removal of the fat transplant.

to Bauchman's technique, the joint transplants have always included their entire capsules, and in view of their small size it is not difficult to accomplish this and is necessary to hold them together. I, myself, am not concerned with such operations. The end-results have not been reported in the literature.

The same thing holds true for homoplastic grafts from freshly amputated limbs, as for half-joint transplants. It is very important to give the transplant a broad contact with the resected surfaces of the bed. For this reason, in removing the material, I saw off the femoral portion in a bow shape rather than in the diagonal or slanting form which I originally used. This is especially important when the femoral stump is not broad.

Figure 6 shows the bow-formed portion of the femur and the disc-shaped portion of tibia, both held together by cross ligaments and meniscus, transplanted into a joint defect which has been exposed by a large flap. If possible, no nails, screws, or sutures are employed. If one places the bow-shaped end of the transplant exactly in the arch formed by

Fig. 14. Exposure of the knee joint for arthroplasty. Modeling of the joint surfaces after Murphy. The raw surface of the patella can be covered with pedicled flaps of fatty tissue from the surrounding area.

the resection of the femoral joint portion, the transplant remains without especial fastening. When foreign bodies are used, resorption can easily occur if the nails are not removed early. In the first case I used nails but later abandoned this practice.

In my first case of knee joint transplantation which was operated upon in 1907, and which on account of destruction of musculature was exceptionally unfavorable, there is still, after 16 years, painless and good weight bearing and joint motion sufficient for going up and down stairs. This is to be all the more wondered at since in this case I undertook several subsequent operations. First, 4 months after the operation an attempt was made to establish a new joint capsule with hydrocele sac—a procedure which is not only entirely unnecessary but which may have injurious consequences through the causation of thick connective tissue masses. Second, I had to repair the defective extension apparatus, in that the long extensor of the toes was turned upward and united with the rest of the quadriceps. Third, the patient during the war was caught in the Russian drive on East Prussia and had to march days at a time. Although the well knee swelled painfully because of overexertion, which it has done repeatedly since, the leg operated upon was given a more severe test, and in spite of this the knee has remained free from pain, though the active mobility has somewhat lessened. In conclusion it is important to

Fig. 15. Exposure of the elbow joint for arthroplasty.

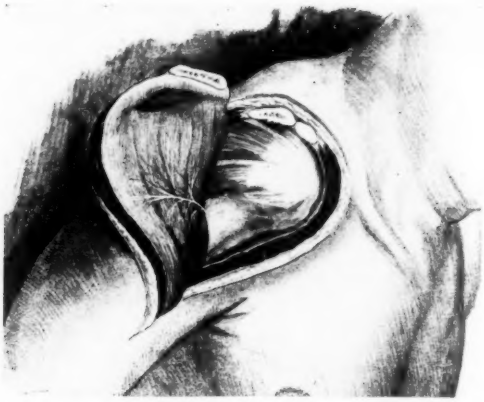


Fig. 16. Exposure of the shoulder joint for arthroplasty.

remember that the soft tissues were extensively scarred as a result of a protracted suppuration which caused bony ankylosis, and that the masses of scar tissue could not be completely removed. Also motion and weight bearing were allowed much too early, 5 weeks after operation. This case has been followed for 10 years with roentgenograms.

After one-half year (Fig. 7, a) not the slightest changes were to be seen. After 1 year and 4 months (Fig. 7, b) there set in at the locations of union a bone thickening which also affected the transplant. The condyles are in good shape but the tibial surface has become irregular. In the callous tissue of the knee space are bone shadows.

After 1 year and 7 months the roentgenogram, a front view, shows (Fig. 7, c) that the formation of marginal elevations is beginning. After 3 years and 9 months (Figs. 7, d and e) the two joint surfaces are irregular, the transplant has in part disappeared and has been in part replaced by thick bone tissue. After 5 years and 9 months (Figs. 7, f and g) the marginal eminences have become broadened and thickened. The thickening of the transplant rest has increased and the tibial surface appears hollowed out.

After 10 years (Figs. 7, h and i) the marginal eminences especially on the inner side, are broadened and thickened; the bone proliferations on the posterior side of the tibial joint edge reach across the joint space upward; they have united with the bone formation in the scar, so that motion is hindered. The tibial joint surface is still more deeply hollowed out and irregular. A relatively large amount of substance of the condyles remains and is sclerotically replaced. The joint surface of the femur is irregular.

In another case the changes were also very interesting and typical. Following a pus infection of the joint the patient, 17 years old, had a very broad bony ankylosis in flexed and slight varus position. The transplant was removed and implanted as in Figure 6. After 5 months, the patient was walking in a weight bearing splint, with complete extension, active flexion to 60 degrees, passive to 70, and excellent ability to bear weight. The films (Figs. 9, a and b; and Figs. 10, a, b, c, d, e, f) were made 6 months after operation. The roentgen exposures show until 2 years after the operation smooth joint surfaces and in flexion complete use of the condyles (Fig. 10, c). Not until 3 years after the operation did we succeed in obtaining a follow-up examination of the patient. He had in the meantime performed at home very difficult farm work and had undertaken no motion exercises. The joint region appeared somewhat swollen compared to its former condition, but was capable of good weight bearing and was painless. In bending active mobility was some-

what lessened, but passive mobility was good. With the hand one could feel on motion a distinct rubbing. After 6 years (1919) the patient allowed another examination. In order not to have to go into the military service, to which he belonged, he had accustomed himself to walk with a stiff extended leg, but in spite of this the active motion had diminished only about 10 degrees.

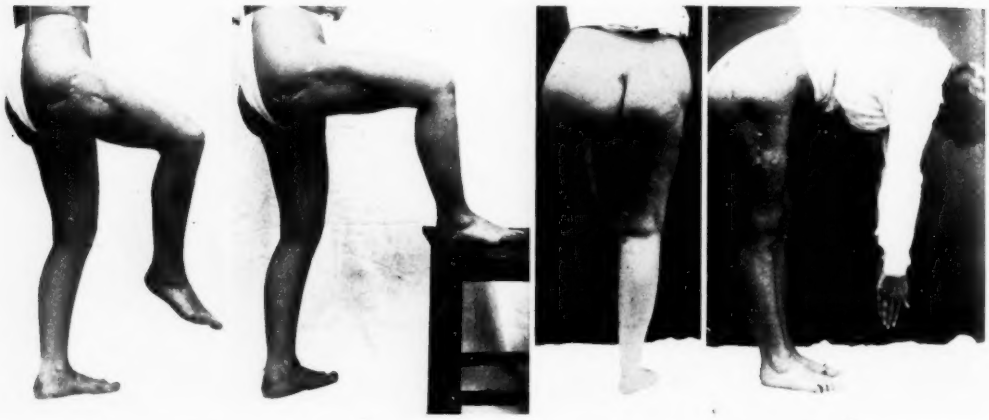
The roentgenograms show some important changes. Figure 10, a, shows good fitting of the joint surfaces after 3 weeks, as does Figure 10, b, a side view. Figure 10, c, shows the limb in the position of flexion 1 year after operation. It shows the use of the condyles and the sliding of the patella on the patellar surface of the transplant. The border between the transplant and the stump can be seen on both sides through a heavier thickening. Between the tibial joint surface and tibial stump there is on the anterior edge light textured bone. Figure 10, d, made 3 years after operation, shows principally a flattening of the condyles. The bone thickening has forced its way into the clearly distinguishable joint space. A broad bone proliferation extends out from the face of the patella, but the patella is nevertheless movable. The brightened area underneath the anterior end of the transplant of the tibia is resorbed and bounded by thickened bone so that it (the bone) looms up like a marginal elevation. Behind, the condyles are broadened toward the knee bed and show forth in the picture as a broad pedicled exostosis-like mass of bone, which, however, does not hinder an active flexion of 45 degrees and a passive of 60. This is explained by the fact that a palpable bone mass extends out from the posterior portion of the median edge. After 6 years (Fig. 10, c) the patella appears to be held up by a broad pedicled mushroom-shaped exostosis of the femur; it is nevertheless motile and slides back and forth on flexion and extension. The anterior tibial edge is still more proliferated and strongly thickened. The broad exostosis behind is lightened up and in the picture is more blurred; the joint space is well preserved, with relatively smooth margin, and limited by thickened bone. In the pictures taken anteriorly (Fig. 10, f) this is to be seen.

Fig. 17. Exposure of the hand joint for arthroplasty.

Calluses are present on the inner edge of the femur as well as the tibia.

My material, which comprises 23 cases, is concerned with 12 permanently cured cases: 3 finger joints; 9 knee joints. Of the latter, 8 were bony ankyloses after suppuration or injury, and 1 was a joint defect after resection. Two further cases subsequently went bad, after firm healing and motion were present. One in consequence of infection at a later homoplastic restoration operation on ligamentum patellæ, 1 through early departure from the clinic. In the latter case a suture abscess set in which developed into an acute phlegmon which the resident doctor unfortunately believed could be handled only through amputation. A further healed case of extensive knee joint defect is excluded, because the patient failed to return to the clinic after 6 months.

Of 8 failures 1 was due to a severe postoperative hæmorrhage, the result of a bloodless operation, which is a mistake in any case of transplantation. After raising the flap on the second day to remove the hæmatoma I had no hope for union with nourishment so took the transplant out. In 3 cases of knee synostosis following joint and bone tuberculosis, there developed after preliminary healing 4 to 5 months later, abscesses and fistulæ in which



a. *b.* *c.* *d.*

Fig. 18. Bony ankylosis of the hip joint in a woman 28 years old, 1½ years after operation. (See Fig. 19.) a, Active flexion of the thigh; b, passive flexion of the thigh; c, standing on the operated leg. There is no tipping of the pelvis; d, showing that there was no difficulty in bending of the body forward.

tubercle bacilli could be demonstrated in the granulations. Two knee synostoses following suppurative osteomyelitis from the beginning were questionable since at operation encapsulated foci of pus were found in the bone. In spite of the fact that the foci were removed and the bone was disinfected with tincture of iodine, suppuration promptly developed and necessitated the removal of the graft. In a case of synostosis of the tibiotarsal joint caused by tuberculosis which was repaired by transplantation of the corresponding joint surfaces, a recurrence soon developed. In an extensive defect of the elbow joint caused by a war injury, an accident frustrated the result after good healing. In this case we were fortunate in securing an elbow joint from a patient upon whom a high amputation of an arm had been done for angiosclerotic gangrene of the hand. I ventured to transplant the corresponding elbow joint including a 12 centimeter section of the ulna and a 5 centimeter section of the humerus. Healing proceeded at first in a favorable manner so that after 8 weeks the bone ends which had been secured with pegs remained firm and motion could be cautiously begun; but the patient made a misstep and stumbled on some stone stairs and thrust the repaired elbow violently upward so that a large effusion of blood occurred and the scar tore open and a fistula formed. In spite of the fact that during the fistulous suppuration a sequestrum loosened from the ulna, both joint ends recovered for the most part and showed in the roentgenogram that through periosteal proliferation they had entered into firm union with the stump ends. The case was later discharged with a flail-like joint.

Of the 12 cases in which I can consider the transplant as permanently healed, there were 2 knee joint cases which were discharged with good motion and weight bearing capacity after 1½ years, but later reports are lacking since the cases came to my clinic from Russia. Likewise I have been unable to examine again any of the 3 finger joint cases. These cases were discharged after good healing with painless but not yet completely normal mobility. I have been able to follow 6 knee joint cases at least for a few years, and several cases to date. Although the first attempts are among those and although many things occurred at operation which I must today view as mistakes or as injudicious, still the changes which have set in in the course of years can as a whole be viewed as a good picture, in so far as one is able to judge from roentgenograms.

The grafting result, clinically the good supporting capacity with increasing painless mobility, and in X-ray pictures the good restoration of the joint portions with smooth

Fig. 19 (left). Roentgenogram illustrating bony ankylosis of the hip joint. (This is the same case as that shown in Figure 18.)

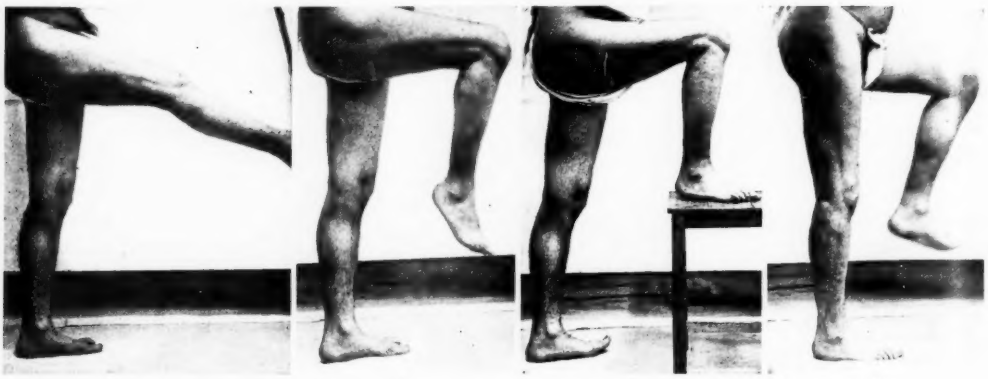
Fig. 20. Same case as in Figures 18 and 19, 1½ years after the operation. Walking absolutely normal. Sport activities excellent, i. e. riding a wheel and skiing.

joint surfaces and bony growth at the site of union are found to persist in the knee joint after 2 years. Even when the clinical result relative to motion has decreased but little and at that under special conditions (excessive exertion, etc.), the X-ray pictures show nevertheless marked changes, which one must consider as typical. They concern the behavior of the spongiosa and of the joint cartilage.

Judging from the histological findings the living transformation of the spongiosa begins very slowly. First the zone of union thickens, then broadens, while definite thick bone substance grows forward into the spongiosa of the transplant. But in the meantime the spongiosa, which lies below the joint cartilage, degenerates, that is, it becomes yielding so that the joint surface is pressed in. The resorption is more marked and quicker than the restoration process. That this most concerns the parts lying farthest from nourishment is not to be wondered at. It is for this reason that the rounding of the condyles disappears. As far as function is concerned, the condyles are apparently worthless but not more so than they would be if vascularization and resorption had taken place with insufficient transformation. These changes occurred in many condyles relatively suddenly and appeared as traumatic grinding (Fig. 11, a, b, c).

The condition shown in Figure 11, a, was maintained until shortly before Figure 11, b, was made 2 years later. After 6 years the changes are still more marked (Fig. 11, c) without hindering the mobility (Fig. 12).

As the spongiosa becomes soft and yielding, in the X-ray pictures the joint surface shows up as irregular, and bone proliferation begins at the margin which with time, however, can grow in excess. These proliferations are very



a. *b.* *c.* *d.*

Fig. 21. Same case as in Figure 22; 43-year-old man 2 years after the operation; a, active extension of the knee joint; b, active flexion; c, passive flexion; d, standing on the operated leg.

similar to the marginal eminences of arthritis deformans. They may extend under the ligamentum patellæ and inside of the compensatory capsule tissue of the knee space. Where the joint portion of the femur was wider than the stump, there developed on the upper surface of the joint an exostosis-like formation. Here the new formations caused broadening of the joint region.

The marginal eminences show at first in the X-ray picture as weak shadows. Gradually they thicken and spread. Only then is the permanent condition reached. In one case there appeared after 2 years a spangle-shaped shadow on the anterior side of the joint. It seemed as though the patellar band were ossifying and still the spangle was connected with neither the tibia nor the femur. Possibly it had been torn loose. First the shadow became denser, then later it became clear again. Active mobility was not much interfered with, so that after 7 years there was possible an active flexion of 50 degrees from full extension, while in the first 2 years there had been flexion of 70 degrees. In another case (Fig. 12; also Fig. 11, a, b, c) the active flexion had conversely increased; after 6 years to 80 degrees, and after 12 years to 90 degrees.

The peculiar changes at the marginal portions of the cartilage unfortunately could never be examined histologically. Chronologically the occurrence is connected with the mechanical influences of weight and motion. Probably the condition is caused by the irritation of weight and motion on the compensatory capsule, since just where it is grown fast to the cartilage margin there is always a pulling. These marginal portions where the cartilage comes in contact with the periosteum, perichondrium and synovial rest of the transplant, are the parts first nourished. Here the tissue is the earliest to be transformed, wherefore every irritation must give rise to proliferation. In similar manner one often sees after joint fractures, callus proliferation at the cartilage margin after powerful motion exercises have been undertaken, and also their retrogression, and with this, improvement in motion, when these exercises cease.

The transplantation of an entire joint together with joint capsule, has been undertaken by myself once on the knee joint, in the unfortunate case already mentioned, and by Deutschlaender likewise on the knee joint. But suppuration and casting off of joint connective tissue set in. Oehlecker had better results with finger joints. But here there were marked changes also.

The clinical experiences with the closed joints agree with the results of animal experimentation by Dalla Vedova. As I feared in the beginning the transplantations failed because of disturbances of nourishment. Only in the autoplastic operation, and then with small joints, as Bauchman and Goebel have

a. *b.*

Fig. 22. Fibro-bony ankylosis of the knee joint. (Same case as in Figure 21, 2 years after the operation.) a (left), From the front; b, from the side.

shown, is a result possible. But none of the observations extend over as much as 1 year.

With the homoplastic operation without capsule, brilliant results are obtained, but the changes which occur after years show, in spite of the good clinical results, that the joint cartilage (it matters not whether a copious or thin layer of bone is transplanted with it) is not entirely maintained and regenerated, but an irregular joint surface arises. The cartilage surfaces remain smooth for 1 to 2 years, then irregularities, the origin of which is clearly connected with the institution of functional demands, appear and progress for years. They resemble very much in their nature and cause the joint changes in arthritis deformans; above all, however, the marginal zone of the cartilage appears capable of proliferation under functional demands, which must be due to its composition of cartilage and periosteum and to the irritating pull and pressure forces which attack exactly at this point.

Cases suitable for joint transplantation are limited. The first attempts were almost all undertaken on broad joint ankyloses; but the operative procedures for the mobilization of stiffened joints which have in the meantime been tried out and tested with pedicled and unpedicled tissue interpositions approach the goal more nearly, are more permanent as to results, and are not *dependent* on homoplastic material, which is difficult to maintain. An open question remains as to how the joints would have held up if they had been relieved of weight for several years, and if weight bearing had not been started until after the spongiosa had undergone the transformation necessary for firmness. Then probably the breaking in of the spongiosa would cease, and with it the degeneration of the sensitive overlying cartilage, but the pulling on the marginal joint cartilage caused by the necessary exercises remains as cause of the proliferation.

Joint transplantation today is to be recommended only for large and especially for fresh operative joint defects. Still, according to experience to date, it is not advisable to attempt the replacement of the large, broad bone portions simultaneously with the re-

Fig. 23. Bony ankylosis fracture of the malleoli in abducted position. Fifty-one year old woman 7 months after the operation. Extension and flexion of the foot. Walking good.

placement of the joint. The former above all is most important. Before everything else it is important that the slow transformation of the spongiosa be hastened in every way possible. With the joint portions covered with cortex and joint cartilage this is clearly as a rule slow. To this end the joint cartilage, which hinders the quick nourishment of the middle spongiosa portion, must be removed either entirely or at least extensively along the marginal region. This has also the other great advantage that the border zone of periosteum and cartilage, which favors proliferation, has been removed.

Indeed, in cases of half-joint transplantations, in which it was necessary to decrease the too wide epiphyseal portion by removal of cartilage and corticalis, or by removal of a half epiphyseal side, I have seen not the slightest marginal proliferation. In one case which is especially to the point, the malleolar end of the tibia of an amputated leg was reduced circularly on the joint end to replace the ulna, so that between the joint cartilage and the corticalis of the diaphysis there was practically nothing but spongiosa. It was well maintained after 11 years and without any proliferation, and there was brilliant function (piano and organ playing). In case of a weight bearing joint the corticalis should not be removed on all sides, as the scant, but for the ulna sufficient, thickening of the spongiosa in this case might mislead one to suppose.

In the future it must be decided in suitable clinical cases whether this removal of the marginal cartilage zone can serve to better nourish the subchondral spongiosa or whether it is better entirely to renounce the joint cartilage and to transplant only the corresponding bone portions, and later obtain motion by interposing fat tissue or fascia.

Relative to transplantation from fresh cadavers, I have had access to only 2 cases. From a healthy young male who had been executed, I was able to obtain and remove in the operating room the entire knee joint and to transplant it. The transplant healed in well, but when I removed it 5 months later because of complete stiffening, there had grown around it a hard thick callus of connective tissue, as a result of the reaction of the tissue of the transplant bed to the degenerating material adhering to the transplant. An elbow, which I was able to remove with very large parts of the ulna and humerus immediately after the death of a man from skull fracture, did not heal in because the very shriveled soft tissues, which could be closed only with tension, were responsible for the failure of the sutures.

ARTHROPLASTY

For many decades attempts have been made to mobilize stiffened joints. MacAusland in a recent publication in this periodical was the first to write up the history of these attempts. Helfreichs' muscle interposition in synostoses of the jaw gave an impetus to the development of the operation. He also recommended this procedure, indeed he used pedicled flaps for the hip joint. The operation produces a condition which resembles that which after fracture causes a false joint. But the most significant service and the greatest advancements we owe to the immortal Murphy who worked untiringly in this field and who communicated his finished and splendid results at the American Surgical Congress in 1914. He worked out good opera-

tive technique for all joints. He showed that the bone ends after resection of a stiffened joint must be so shaped with a fine chisel, and he devised a special instrument for this purpose that the bone would roughly resemble the shape of the joint. For interposition he used mostly fat and fascial flaps. He worked less with free transplants of fat and fascia.

In the larger joints I have attempted to prevent the recurrence of ankylosis by polishing the joint surfaces—in part by impressing sterile wax before filing and by filling the joint space with sterile oil, since this allows no blood clots to develop. As I had no luck with this method, in 1906 I twice resorted to the interposition of fatty tissue in the elbow, as this method had proved of value in a similar application of the fat pad of the cheek to the jaw joint. In these cases, however, reported in January, 1911, the after-treatment was unusually painful—because of the responsible gonococcal infection—so that a good result was not obtained. Since 1910, I have used the procedure and have studied the changes in the interposed fatty tissue.

At the International Congress, New York, in 1914, Murphy mentioned my results as astonishingly good, although they were hardly as excellent as his, and said: "Free transplantation opens a great future for arthoplasty." He informed me that he also occasionally had employed instead of pedicled fascial and fat flaps, free flaps only of fatty tissue.

Chaput reported in May, 1911, a case of free fatty tissue transplantation in a case of elbow ankylosis, which he followed in 1912 with 2 further cases. Amédée Baumgarten announced at the French Surgical Congress, 1913, the cases of Chaput as the first, but in this he was not correct. My earlier report had escaped his attention. While I introduced the free fat tissue transplantation into joint surgery as an operation for ankylosis, my assistant, Roepke, to retain mobility applied the same procedure by inserting fatty tissue after the opening of diseased joints. He used this method first in cases of arthritis deformans after smoothing off the joint cartilage, then in cases in which tuberculous foci lying in the bone near the joint cartilage had been removed, and for replacement of removed injured meniscus in the knee joint. These are also today the most important indications. To these indications I have added cases with fresh shelling off of the joint cartilage after severe contusions and gunshot wounds. It was interesting to investigate in what manner the interposed fat flap changed and in what manner a new articular space arose. Murphy believed in a hygroma-like transformation. This will occur in case of well nourished pedicled flaps as they are capable of inflammatory reaction, but not in case of free transplants of fatty tissue. Animal research could not be used to decide this question. I must first obtain information by reoperating on man in order to receive light. The fatty tissue flap gets its nourishment from the freshened joint ends where it spreads out over the articular space, and also from the connective tissue of the bed. There nourishment comes through union and here the fatty tissue endures or regenerates the middle layer out of which later the articular space originates changes. Oil cysts occur which are covered only by thin connective tissue. As soon as the functional demands of the joint ends set in, there begins a fatty tissue metamorphosis concerning

Fig. 24. Ankylosis of the right shoulder joint following a healed tuberculosis; 6 months after the operation. a, Active raising of the arm; b, passive raising of the arm.

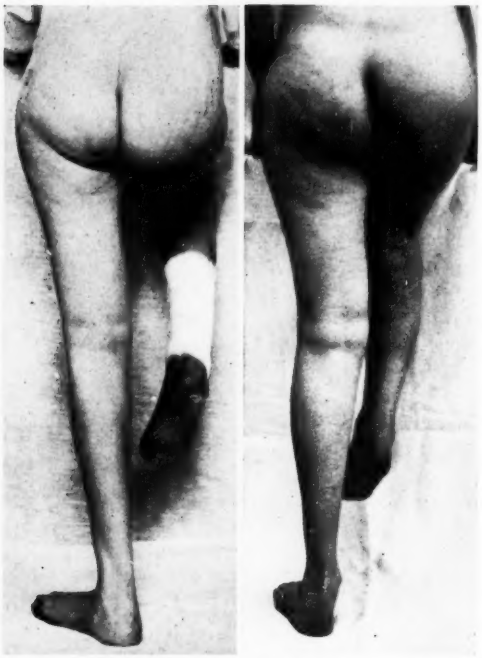


Fig. 25 (left). Paralysis of the gluteal muscles on the left side. Woman 23 years old. Sinking of the pelvis when standing on the left leg.

Fig. 26. Same case as in Figure 25, 4 months after the attachment of the tensor fasciæ latæ to the trochanter major. The sinking of the pelvis has disappeared.

which my assistant, Rehn, reported at the International Surgical Congress, New York, 1914. The connective-tissue part of the transplant, which is in part regenerated and in part restored through the germinal tissue of the bed, proliferates greatly under this influence, while the fat cells degenerate. There develops at all points of the joint surface where there is pressure and slipping a layer several millimeters thick of very dense connective tissue, poor in blood vessels. I found in several cases reoperated upon that in this connective tissue callus, there had developed after 13 months a transformation into fibrous cartilage, and an endothelial-like cell covering in the articular space. The fatty tissue endures as such only where it is less exposed to the pressure or the slipping motion of the joint surfaces. Thus, there form entirely on their own responsibility, meniscus-like calluses in the knee-joint. The cysts of the middle zone, which originate through degeneration, join together to form larger cavities because their thin septa gradually tear as a result of joint function; the fat which is freed is resorbed and the walls of the former cysts finally lie close together as fine, smaller, or larger space formations. Occasional cases of joints which were of good mobility when operated upon the second time, showed only one single large articular space present without adjacent adhesions.

I have always preferred fatty tissue flaps without pedicles to the pedicled ones since the pedicle of these flaps is hardly satisfactory for good nourishment; for at the place where the flap is turned into the joint, it must necessarily be pressed by the surrounding muscles. Besides this, the transplant without a pedicle has the advantage that the joint on all sides can be closed with simultaneous fastening of the previously separated ligaments. Opposed to the free fascial transplant, the fatty tissue has, according to my opinion, many advantages. The fascial flap is only a thin membrane. It necessitates thus the most exact patterning with reciprocal articulation of the joint surfaces. When they do not exactly articulate, blood will collect, the organization of which may cause adhesions as is always the case. Indeed in two attempts with free fascial flaps in the knee joint, I have had such adhesions develop and have proved their existence at a second operation. One can prevent adhesions only by very exact patterning of the joint surfaces and through restoration of a relatively wide space between them. In the arm joints this has no harmful consequence, but in the knee joint the capacity for weight bearing may suffer because of the occurrence of a wobbly joint. In contrast to this the fatty tissue flap fits snugly into all irregularities and hollows by virtue of its elasticity and besides this has the advantage that by means of this snug fitting it stops the bleeding, as every autoplastic tissue graft does. Also the freed fat acts as would oil to guard against clotting. Because of all these natural advantages, not only those that are evident at the time of operation but also the ability (as shown by Rehn) of changing into a

callous tissue enclosing a new articular space, I consider fatty tissue as the best material for interposition after separation in synostosis and ankylosis of the joint, and for the restoration of limited joint cartilage defects.

The manner in which I lay open the different joints is absolutely uniform. Always a large flap is made from the soft tissue of the joint region and the musculature that bridges over the joint. The tendons of these muscles are not severed but their insertion to the bone is loosened together with a thin plate of bone. This has the great advantage that the insertion of the muscle can be transposed, as is especially necessary in the hip, since through downward transposition of the separated trochanter major, the middle gluteal muscle so important for holding firm the pelvis, can be brought into greater tension. Other surgeons avoid separating the muscle from its insertion, but in the lateral opening of a joint one does not invariably obtain good approach and it is not so easy to form correctly the joint surfaces as it is after wider opening.

In opening the hip joint its natural curves are followed and separation is made from the trochanter. The flap consists of a block of tissue composed of skin to muscle (glutæus medius). The different portions are not separated as is done in Murphy's operation (Fig. 13).

In knee joint cases an anterior flap is formed with which laterally, close to the posterior edge of the condyle, the fascial reinforcements and lateral margins are cut through longitudinally. The tuberosity of the tibia is chiseled off flat so that it remains connected with the patellar ligament. If the adherent knee cap must be separated from the femur by chisel, the entire flap surrounding the lower portion of the quadriceps is prepared as far upward as the suprapatellar bursa normally reaches (Fig. 14).

For the elbow a similar flap is made on the extensor side with flat removal of the tip of the olecranon (Fig. 15).

For the foot the dorsal flap must reach far downward to the vicinity of the head of the metatarsal bone, because the dorsal skin of the foot is nourished by the dorsalis pedis artery. The severed extensor tendons remain included in the flap and are reflected back with it over the calcaneotibial joint above.

At the shoulder joint a curved incision is carried out beginning over the acromial process (which is chiseled off) and proceeding along the lower border of the clavicle to its middle third from which the fibers of the deltoid must everywhere be separated. Then the incision runs along the anterior edge of this muscle according to the necessity of the case to its attachment to the humerus (Fig. 16). For the wrist I prefer a curved posterior incision, likewise for the finger joints (Fig. 17). With these directions for incision the vessel and nerve supplies of the reflected tissue are insured.

After severing the connective tissue or bony synostoses, the bone ends are formed to conform as near as possible with the normal bone —the splendid instrument designed by Murphy being used. I have had the best results with this instrument and have used it in preparing the acetabulum and the head of the femur. The chiseling and filing must not be done with electricity, however; I experienced once the separation of shell-like sequestra so that I now use for smoothing the acetabulum and femoral head only the hand, although very great force is necessary for this. It is, of course, understood that at the prepared joint ends any remaining periosteum should be removed to prevent proliferation. Scar tissue remnants of the capsule must be removed, and the ligaments must be protected as much as possible and sutured if they have to be separated. It is further evident that bleeding must be absolutely stopped. The articular space in the knee joint is made about a thumb's thickness in breadth; in the hip and ankle it is made somewhat narrower; and still narrower in the joints of the arm; and narrowest in the finger joints.

The removal of the fatty tissue flap is done with a large sharp knife and the flap is taken from the posterior lateral side of the thigh. Here even in thin individuals the fatty tissue is sufficient. The flap is immediately laid in the defect and fastened with only a few stitches over the lower or upper femoral end in the knee and hip joint respectively; in the shoulder joint on the head of the humerus; in

the elbow on the lower end of the humerus. After that under strong pull and counter-pull the proper position of the joint ends occurs.

The fatty tissue which is superfluous is removed. The separated ligaments are fastened to the periosteum, the separated bone insertion (trochanter, tuberositas tibiæ, olecranon, acromion) is fastened to the bone with a fine nail or with periosteal stitches. For transposition of the trochanter, which I always prefer in hip joints, the muscle together with periosteum is divided longitudinally by a long incision under the place from which the trochanter has been removed, and is retracted to one side. From the corticalis a small plate is removed. At this point the trochanter process is nailed on in strong abduction. If the glutæus medius is very atrophic, as in old ankyloses, the tensor fasciæ is used also (see below). The soft tissues over the articular space are closed everywhere with exactness with catgut. Drainage is never used. The control of bleeding must be so absolute that drainage is not necessary. Likewise the skin is completely sutured, and the different joints remain immobilized in casts for different periods of time.

The operation gives only the basis for results—the after-care obtains them. It is necessary to steer between two great dangers. One danger is a wobbly joint, the other is a recurrence of the stiffness. It is therefore necessary to know the causes of each.

A flail joint may easily arise when, because of the pathological process, the lateral ligaments are destroyed and when in resecting ankyloses too wide a space is made between surfaces. One obtains with the latter relatively early excellent active motion—but in the knee or hip joint good weight-bearing capacity is not obtained. In the elbow the lower arm bends ulnaward if a heavy object is held with the upper arm raised. In the wrist, subluxations develop. Knee joints, which in 2 months can be moved more than 90 degrees, become wobbly later, i. e. they deviate in abduction or adduction. Of course, the interposed fatty tissue does not often give cause for flail joints. In my material there is only 1 elbow case (after severe gunshot wound) and 2 knee joint cases (in very fat women) in which this abnormal mobility appeared and made necessary an operation on the joint ligaments. Flail joints are seen more commonly after fascial interpositions are used. Slight degrees of abnormal mobility can disappear as a result of muscular strengthening but recur in greater degree when casual sickness in bed results in inactivity. I have seen this occur temporarily in a knee joint after appendicitis.

Stiffening recurs naturally every time there is an infection. This is not always due to operation, but occurs after suppuration of all kinds, especially after severe injuries, as after latent infection following war injuries. In order to prevent as far as possible suppuration after operation, at least one-half year after closure of the last fistula should elapse before operation. But even this is an indefinite limit, for after even a longer time an encapsulated small abscess may be encountered, likewise invisible encapsulated masses of bacteria. Besides this there is a certain hypersensitiveness of the tissue to all irritations. Among my cases of war gunshot injuries, out of 27 operated upon for knee joint ankylosis 4 became stiffened again through latent infection and out of 36 elbows operated upon, 3 suppurated without affecting mobility. In one knee joint following war injury (gunshot) I found on separating the bony ankylosis a bone abscess the size of a cherry. I removed it and filled the space with fatty tissue and finished the operation in the usual manner. Healing without reaction and excellent function resulted.

Other reasons for recurrence of stiffening are found in the overdevelopment of connective tissue in the tissue surrounding the joint. In spite of primary healing in a case following a war gunshot injury, stiffening occurred which I believe was due to hypersensitiveness of the tissue. The hypersensitiveness was caused by the previous severe and long lasting suppuration.

The earlier one tries to mobilize a joint with fatty tissue, the more apt is he to have stiffening. The same is true in the healing of fractures with interposed tissue. As is known, we have not succeeded experimentally in obtaining a pseudarthrosis by interposition of soft tissue when there is constant motion, for the inserted tissue is rubbed to pieces and the

callus masses are able to unite. In the larger joints the first movement should never be begun before 4 weeks after operation because the fatty tissue otherwise will be completely destroyed. It is essential that the fatty tissue regenerates completely in its nourished layer so that metamorphosis into a connective-tissue callus may take place under the influence of functional demands. Not until this condition is reached is there protection against bone proliferation which may be produced by irritation through movements; not until then are the freshened bone ends entirely covered and this injurious proliferation guarded against.

But exercises instituted too late frustrate results. In children and sensitive hysterical patients, without will power, (also those who have been in accidents and who have invalid's income play a rôle) and in cases in which the joint is cautiously protected from every motion, connective-tissue stiffening may occur. If one attempts to hasten the progress of exercise by force under narcosis, the good result as a rule is very transient. The tissue injury which is produced is accompanied by bleeding. The blood effusions and the traumatic irritation work forcibly on the germinal connective tissue, which has originated in the healed-in fatty tissue so that connective tissue stiffening results. I have, therefore, always warned against forceful movements under narcosis; I have operated upon many soldiers with ankyloses entirely the result of superfluous and injurious brisement forcé.

Only in joints in which because of the illness all securing ligaments and joint apparatus have been destroyed is it of great advantage to keep up exercises longer than usual. Thereby one obtains with the fatty transplant more secure connective tissue masses in the vicinity of the joint, in the knee joint especially in the posterior and lateral portions. Thus exercises are kept up until this goal is attained.

In general, the immobilizing cast (plaster cast with extension, the latter to prevent pressure on the fat) is left on at least 4 weeks—16 weeks on the knee and hip, only 2 weeks on the finger joints. Then follow for 2 weeks active motion and muscle massage; and after that, systematic passive joint exercises and cautious exercise with apparatus are begun; weight bearing follows, in leg joints at the earliest after 6 weeks. I have never permitted weight-diverting apparatus to be worn, because they are too expensive. It suffices that the patient walks with crutches. Taylor's apparatus is most highly recommended.

The duration of the treatment is different for the different joints. The hip joint needs the longest time. Treatment should be continued until in addition to good mobility and weight bearing a normal gait is attained. This is essentially concerned with the musculature which will be discussed later. The knee joint is capable of complete function after one-half year. Also after the conclusion of treatment the mobility improves further through daily use at work. In the knee joint of a soldier who left the clinic with a scarcely movable joint because he did not like the exercise treatment, excellent mobility resulted when he was forced by a sudden storm to run down a mountain. This man is a dancer in a Bavarian mountain resort and is able to follow fully his calling. A lady of 45, whose knee had been operated upon ascended a Bavarian mountain and after that had much greater mobility and strength in her leg.

In selecting cases above all one should exclude children, the weak-willed, run-down, and nervous patients; likewise all patients with joints with marked muscular atrophy and scar tissue formation in the skin and soft parts. It is evident that one should not undertake mobilizing operations on paralyzed legs. A few examples of the different joints are given in the illustrations (Figs. 18 to 24). For the others I refer to my material up to 1916 which is described in my book *Free Transplantations*.

Following is a review of the results which have been obtained to date. The sign + indicates a good result, if the mobility attained is normal or at least sufficient for daily use. The cases marked as questionable (?) are either too recent for judging or because of death due to some other cause are not satisfactory for judging relative to the joint; (−) indicates failure, due in part to latent infection, in part to recurring tuberculosis, in part to too early separation from the clinical treatment with resulting recurrence of stiffening.

A total of 300 cases of large joints have been operated upon of which 242 are very good or good, 34 are failures, and 24 are questionable. The cases are grouped according to the individual joints:

Knee joint	60+;	13−;	6?
Elbow	84+;	4−;	2?
Wrist	14+;	0−;	0?
Shoulder	12+;	1−;	2?
Ankle	10+;	0−;	0?
Hip	62+;	16−;	14?

In general the indication for operation resulted through connective tissue and bony ankylosis and through joint injury and arthritis deformans. There are special indications in the case of the hip joint, and I have worked out, along the lines of the operation for ankylosis, a corresponding operation with fatty tissue insertion for congenital hip joint dislocation. A similar operation is performed for medial fractures of the neck of the femur and pseudarthroses, for severe cases of coxa vara and changes of the joint cartilage in Perthes' disease. The different hip joint cases are classified as follows:

Gunshot wound with stiffening	1+;	0−;	0?
Central luxations	1+;	0−;	0?
Ankyloses	17+;	6−;	6?
Fractures of neck of femur and pseudarthrosis	11+;	1−;	7?
Congenital luxations in adults	19+;	2−;	0?
Congenital luxations in children	4+;	5−;	1?
Coxa vara and arthritis deformans	9+;	2−;	0?

In severe coxa vara and arthritis deformans I have removed the entire cartilage from both the femoral head and the acetabulum and completely taken away the capsule, which as a rule has proliferated, after the joint has been laid open, exactly as is seen in the illustration (Fig. 14), for the ankylosis operation. Relative to the illustration it is to be noted that only in the very first cases was it necessary for me to cut through the small pelvic muscles (musculus obturator internus, piriformis, and gemelli) and suture them together. In most cases I succeeded in luxating the femoral head satisfactorily, without doing the separation described by Murphy. In arthritis deformans and coxa vara, after the head of the femur has been made smaller and shaped approximately normal, it is covered with fatty tissue and placed in the joint.

I have described a special operation for fracture of the femoral head and pseudarthrosis. After the joint region has been laid open, as in the operation for ankylosis, the stump of the neck is luxated and the head, which as a rule is necrotic, is removed. The acetabulum is smoothed, the stump of the neck is rounded off by fraising, covered with fatty tissue, and placed in the acetabulum. So far the operation is like that for ankylosis. However, in order to prevent luxation of the shortened upper end of the femur, a bony wall is prepared on the upper edge of the acetabulum. After the periosteum has been raised pocket-like upward a corresponding portion of bone is fastened with a nail at this location in the pelvis close above the upper edge of the acetabulum. It lies in the periosteal pocket and consequently grows fast quickly. It forms later a good bone shelf for the shortened head of the femur. I have usually fashioned this piece of bone from the removed head of the femur. In spite of the fact that this operation was on elderly people, 50 to 60 years of age, it has given excellent capacity and mobility. I consider the operation indicated (1) in femoral neck pseudarthrosis and (2) in the so-called medial fractures where the head is broken off close to the periosteal attachment and consequently callus cannot form. In early cases of this kind operation is undertaken, at the earliest, 3 weeks after injury.

I will mention in passing that at the Surgical Congress in 1918, I reported the use of a bone peg for fastening the neck of the femur in fractures and in pseudarthroses, but I have not used this method for a long time because the transplant is not always able to find bony union in the atrophic tissue of the head and because secondly, the connective tissue of the pseudarthrosis space may erode the peg to the point of breaking it. Later practically the same operation was recommended by Albee and Delbet.

In very severe cases of congenital hip joint dislocation in adults I no longer make a new acetabulum but make a bone cleat on the pelvis close above the head with a piece of bone from the trochanter major following the

method employed in fracture of the neck of the femur. However, if it is possible to draw the head down by extension, I prefer the radical operation.

The technique may be described as follows. After laying open the hip joint with the flap formation described above, an acetabulum is prepared at the proper place and the head is made correspondingly smaller and rounded off. Thereupon it is placed in the acetabulum after being covered with fatty tissue. In hip joint dislocation the trochanter must be transplanted downward with the leg in marked abduction position, so that the glutæus medius receives necessary stretching. In cases of luxations in adults this operation has given excellent results. The oldest patient operated upon was 48 years old. On the other hand, great difficulties have arisen in the after-treatment of children, as is the case with all operations on the hip joint during childhood. Only in a few cases when the exercises could be carried through and continued by intelligent parents at home, were good results obtained.

Later examination of hip joints operated upon has shown that in dislocations in adults, considerable time passes before atrophic gluteal muscles are in condition to hold the pelvis horizontal when the patient stands on the leg operated upon. It has been found further that among cases in which this gluteal function was obtained after operations on the hip joint for other reasons, so that not the slightest deviation of the body toward the side operated upon could be noticed on walking, the power of the glutæus diminished in several years and the so-called Trendelenburg symptom set in again. Being of the opinion that the glutæus medius becomes atrophic and in time loses its function in cases of long lasting ankylosis or congenital dislocation, in recent cases since 1920 I have added two accessory operations. The first is as follows: after securing the trochanteric process with glutæus medius, the musculus tensor fasciæ latæ is separated from the fascia lata and is placed downward over the trochanteric insertion and sutured fast to the thigh. If the glutæus medius is markedly atrophic, I have secondly built a similar 3 fingers wide flap from the posterior portion of the glutæus maximus and have forced it from behind forward over the point of fastening of the tensor fasciæ and sutured it fast.

These accessory operations were devised 2 years ago, when I operated upon a woman of 20 years with poliomyelitis paralysis of the gluteal muscle on the left side (Fig. 25, before the operation). The result was brilliant. Figure 26 shows the normal position of the pelvis 4 months after transplantation of the tensor fasciæ to the thigh underneath the trochanter. In spite of the fact that a paralysis existed in the right foot which necessitated tendon transplantation, normal motion was obtained and the muscles were so strong that the patient could take part in sports. The patient recently was victorious in a polo tournament. As in the last 10 cases, in all operations on the hip joint I will, therefore, carry out regularly the transplantation of the tensor fasciæ latæ and when necessary combine it with a plastic from the glutæus maximus.

Extensive reference to the literature can be found in Lexer's "Wiederherstellungs Chirurgie" (Reconstruction Surgery) Leipzig: Borth; and "Die freien Transplantationen (Free Transplants). Stuttgart: Enke.

RESECTION OF KIDNEY FOR CALCULOUS PYONEPHROSIS[1]

By H. M. RICHTER, M.D., F.A.C.S., and L. M. ZIMMERMAN, M.D., Chicago

A SURVEY of the literature reveals that conservative resection has been but very rarely employed in the treatment of those cases of kidney stone in which there has been a localized destruction of renal tissue. We wish to place on record 1 such case which was satisfactorily treated by excision of the diseased tissues while the greater part of apparently normal kidney substance was conserved.

The patient, E. F. M., male, age 53, complained of symptoms typical of renal calculus of 6 or 8 years' duration. The urine contained albumin and some pus cells, but no blood. The X-ray revealed an irregularly shaped calculus of the coral type occupying three of the calyces in the lower pole of the left kidney, with several smaller shadows indicative apparently of smaller concretions within the kidney substance. The outlines of the kidney suggested an enlargement of that organ. There were no stones in the ureters or bladder.

On cystoscopic examination, there was seen moderate inflammation of the bladder and trabeculation of the mucous membrane. A catheter passed easily on both sides. Urine flowing from the left was blood-tinged.

	Cubic Centimeters Right	Left
Urine in 3 minutes	4	7
Urine in next 30 minutes	8	34
	Per cent	Per cent
Phthalein in 30 minutes	15	23

The pre-operative diagnosis was renal calculus associated with some pyonephrosis on the affected side. Kidney function, however, was maintained, the dye excretion, for some unaccountable reason, being more rapid on the involved side than on the normal.

Operation by H. M. Richter. The left kidney was well exposed through a lumbar incision. The lower third of the kidney was found to be replaced by a thin walled sac containing turbid urine and several calculi. The renal tissue was so completely destroyed that its removal seemed advisable. The remaining two-thirds of the kidney were firm and grossly normal in appearance. In order to conserve this normally functioning portion of the kidney and at the same time to remove the diseased tissues, a partial resection was decided upon. A wedge-shaped section including the entire sacculated lower third, extending down to the pelvis and going well back into firm normal tissue was excised. The cut margins were accurately brought together with catgut and the pelvis was sutured.

During the operation, hæmorrhage was prevented by digital pressure on the renal vessels maintained by an assistant. When this pressure was released at the close of the operation, no material bleeding was noticed. Drains of the cigarette type were inserted and the wound was closed.

The patient left the table in good condition. There was a small amount of bleeding into the dressings during the first 24 hours and for several days the urine contained only enough gross blood to color it. Convalescence was rapid and uneventful. The maximum temperature elevation was 101, and this returned in a few days to normal. The drains were removed 48 hours after operation. At no time was there evidence of urinary leakage. The patient was up on the fifth day, the sutures removed on the eighth, and he was discharged in good condition 2 weeks after the operation.

Microscopic examination of urinary sediment one week after operation failed to reveal any red blood cells. Subsequent urine analyses have all been negative for blood, but some pus cells are still present. Over 3 months have elapsed since the operation, the patient is back at work and feels in all respects perfectly well. Further study of renal function would be of interest, but in the entire absence of symptoms we did not consider ourselves justified in subjecting him to further cystoscopic examination.

The specimen removed at operation measures 7 by 6 by 4.5 centimeters. It comprised the lower half or one-third of the kidney. The kidney substance of this lower pole had been entirely replaced by a thin walled sac, the lining of which was hæmorrhagic. One large coral stone and 2 smaller stones were also removed.

In this case, there was a partial pyonephrosis due to stone in which one-half or two-thirds of the kidney was grossly normal and able to maintain a good excretory function. The lower pole of the kidney, however, was so completely destroyed that leaving it behind appeared inadvisable. Conservative resection enabled us to remove it without sacrifice of the healthy portion.

There are but few cases on record in which partial resection has been employed in this condition. H. H. Young in a recent article states that a brief review of the literature shows but 1 other such report. Since that time, Mursell has reported a case of bilateral kidney stone in which resection was done on both sides with excellent results. On the basis of this case, together with the favorable results elsewhere reported, it is suggested that in selected cases, conservative resection may be more widely used.

[1]From the service of H. M. Richter, Wesley Memorial Hospital.

URETEROCELE; CLINICAL SIGNIFICANCE AND PROCESS OF FORMATION

Report of Four Cases

By DIOMEDE PETILLO, M.D., New York
Urologist, Italian Hospital

SINCE cystoscopic examination has become a routine method in urological practice, ureterocele has entered into the field of genito-urinary specialty as a distinct clinical entity, and, while it was formerly considered an exceptional occurrence, it is at present relatively frequent. The literature on this subject is, however, rather poor, particularly as far as the nature of the lesion is concerned, mainly because the opportunity to make a thorough anatomical investigation on postmortem specimens is really a matter of chance.

Ureterocele is a term which should remain in medical nomenclature. In my opinion it expresses in the most exact and scientific way the peculiar features of the lesion to which it refers. Besides it is short and catchy. The other term, cystic dilation of the end of the ureter, used by many, lacks these qualities and, in addition, is physiologically incorrect.

With few exceptions the discussions of the investigators have been quite monotonously focused on the question whether ureterocele is congenital or acquired. This seems to me rather an unimportant question inasmuch as it neither throws any light on the real nature of the lesion nor helps in suggesting any understanding of the mechanism of its evolution.

On the other hand, the assumption that stenosis of the orifice (congenital or acquired) is the only cause of ureterocele seems to me quite unacceptable, since it does not stand the most obvious criticism.

Lavandera reporting 4 cases and trying to prove both views of the pathogenesis of ureterocele, namely stenosis and its congenital nature, quotes Thomson Walker: "I have observed congenital narrowing of the ureteric orifices in a man whose urinary system was otherwise normal. The finest ureteric catheter or bougie would not pass through the orifices." True, but the man to whom Walker refers had no trace of ureterocele; which would prove, if one case could prove anything, that we have cases, and many of them, of congenital stenosis of the orifices without ureterocele. And note that Walker's case was not that of an infant, which would also prove that congenital stenosis of the ureter may be present for years and years up to adult age and not produce a ureterocele.

What really counts is the fact that every urologist could testify that small, almost punctiform orifices are frequently encountered and that they are merely considered a physiological variety. On the other hand pathological conditions of the bladder may so reduce the caliber of the ureteral meatus as not to permit any attempt at catheterization. So that, should the stenosis of the meatus constitute the etiologic basis of ureterocele, this would be a far more common lesion than it really is.

If we consider the functional value of the ureteral meatus we understand, at least theoretically, why it should not necessarily be of the large caliber type. In fact, it simply represents the opening of a small canal to carry liquid product, a product adjustable to any caliber, provided a *vis a tergo* propels it. When we consider the caliber of the lymphatics or capillary blood vessels or of the uriniferous tubules of the malpighian pyramids, we realize how generous and provident was nature in constructing the opening of the ureter. Besides the ureter in all its extension is an active muscular apparatus that continuously and rhythmically performs its expelling function on the urinary contents: so that if the muscular waves of the ureteral walls could only remain unimpaired the urine would be driven down uninterruptedly no matter how small the meatus.

Let me say here, incidentally, that in 2 of my cases, I was able to introduce a fulgurating electrode and No. 5 catheter in the cavity of the ballooning ureter without changing the size, the shape, and the working of the ureterocele.

This eventually makes us think of other possibilities which, so far as I know, have not yet attracted the attention of the investigators on this particular subject. What causes the urinary stasis in the renal pelvis in cases of ureteral stricture? Is it the stricture itself as such, that is to say, as a mechanical impediment to the free drainage of the urine, or is it a functional disturbance of the rhythmical peristalsis of the ureter?

This in my opinion is a vital question. From the knowledge of physiology we possess at present, we may infer that the ureteral peristalsis begins from the pelvis and goes down rhythmically to the vesical end. The numerous and classical experiments of Protopopow demonstrate that if we tie the ureter in some of its portions, the peristalsis of the portion distal to the tie becomes weaker at first and finally disappears completely. Evidently this is due to the cutting off of the muscular activity of the ureteral wall; so that if we imagine an acute trauma or a nodular cicatricial lesion (stricture) along the course of the ureter, or a pathological condition which would destroy or damage the peripheric nervous elements which conduct and regulate the muscular peristaltic waves of the ureteral wall we will have a lesion analogous, so far as the remote effect is concerned, to that produced by the tying in Protopopow's experiments. Or, in other words, we shall have in the segment distal to the lesion a permanent disturbed equilibrium of the peristaltic movements which will go from a complete paralysis to a more or less pronounced impairment of the physiological function of the ureter.

The immediate consequence is that when the urinary flow reaches point *A* (Fig. 6) where the lesion is located, it will meet a certain resistance which is determined by a somewhat retarded and diminished impetus. So that if the amount of urine up to point *A* possesses an original velocity (n), according to Protopopow's experimental results, this will suffer a relative diminution and will be $n-1, n-2, n-3$ as it descends to lower levels. These units of resistance will inevitably provoke accumulation and stasis in the upper portion and ultimately dilatation.

Apparently we have here a repetition of the process which takes place in the dilatation of the heart when peripheral resistance to the myocardial impulse (arteriosclerosis, hypertension, etc.) is abnormally increased.

If we imagine another lesion rising at point *B* (stone or stricture) the segment *A-B* will then be in the same stage of dilatation (if not in a more favorable one) as the upper section, on account of the augmented resistance to the urinary flow plus the atonic condition *per se* determined by the upper lesion *A*.

Now let us transfer *A* to A^1 and *B* to B^1 where A^1 would represent a lesion involving the adventitia or the musculature of that part of the ureter and B^1 a stenosis (congenital or acquired) of the orifice and we will have a condition of section A^1B^1 which will lead to a dilatation with the typical characteristics of ureterocele.

I am going to report 2 cases by Woskressensky which will give a striking clinical illustration of this view. Just here I want to emphasize that the peculiar features of the ureteral musculature in the intramural portion are more than in the upper portions liable to give the spectacular sacculation which we call ureterocele. In fact, there, the longitudinal fibers divide into two separate bundles the upper one of which, with that of the opposite side, contributes to the formation of the interureteral ridge and the lower one goes down toward the urethral opening forming the lateral limit of the trigone. So that when the ureter enters the bladder cavity it is simply constituted by sparse circular fibers covered by the mucosa, or in other words the ureteral walls here are extremely weakened and prone to dilatation.

Here are the cases described by Woskressensky:

The first case was that of a man who, 3 years before, had been run over by a wagon, with a resulting injury of the lumbar region and urinary symptoms. Cystoscopy showed a sinking of the left corner of the trigone, and the star shaped meatus gaping and sur-

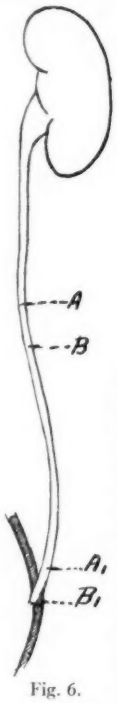


Fig. 6.

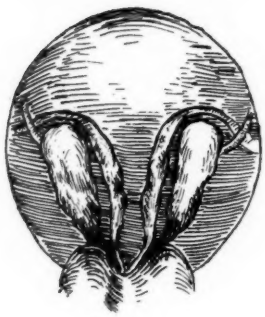


Fig. 7.

rounded by an injected ring. At the operation the kidney ruptured during delivery exuding a cloudy seropurulent liquid; the renal pelvis and ureter were dilated; and 4 centimeters below the origin of the ureter a constriction was seen about 1½ centimeters long. *Below this there was a spindle-shaped dilatation the size of an index finger.* Recovery followed.

Postoperative cystoscopy showed no gaping of the ureteral opening. It was small and did not contract. The author comments that there was no real rupture of the ureter but only a crushing by scar tissue "without changing the lumen." The contusion "caused a paralysis of a great part of the ureter." At first the urinary obstruction was due to the constriction by a hæmatoma and œdema. As these subsided "the paralyzed part gave rise to an immovable column of urine forming hydronephrosis."

The second case was that of a man who was shot in the left renal region. Radiography showed an obstruction at the second lumbar vertebra and, below it, a greatly dilated ureter. Operation showed renal scars, destruction of the peritoneum, of the diaphragmatic crura and its ganglia, the iliac fossa, psoas muscle, spinal ganglia, and upper portion of the ureter. Later ureteral paresis developed with relaxation of the walls.

Woskressensky concludes by affirming that it is possible that dilatation of the remaining section of ureter may occur in these cases when the pathological kidney process involves the ganglia previous to operation (as after extensive perinephritis, a large pyonephrosis,

Fig. 8.

and after removal of a large segment of ureter when branches of peripheral nerves are injured).

We may conclude from these 2 cases that nervous lesions, either ganglionic or peripheral, involving the ureter, must produce a more or less appreciable impairment of the ureteral peristalsis with the ultimate effect of a more or less atonic condition of the ureteral walls; or in other words, a tendency to dilatation would result which would be more or less notable according to the normal or abnormal condition of the caliber of the ureteral segments distal to the determining lesion.

Another important point is that these 2 cases prove clinically what Protopopow had already proved experimentally.

Now let us consider briefly the anatomical relations of the vesical portion of the ureter, its structure and the pathological involvement which it is liable to undergo and we will be able to comprehend clearly the genesis and the clinical value of ureterocele.

In the male the ureter (Fig. 7) after having encircled the pre-ampullary portion of the vas deferens, reaches the base of the bladder at a point where the middle third joins the superior third of the seminal vesicle. It goes between the anterior aspect of the seminal vesicle and the bladder wall and finally pierces the latter with its last section, the intramural segment. In the female the ureter goes through the broad ligament and finally passing through the thickness of the vesicovaginal connective tissue disappears into the walls of the bladder.

These anatomical relations are strikingly demonstrative and it is almost impossible to explain how an inflammatory process of the seminal vesicles, particularly the sclerotic

type, could go through all its phases without involving also the vesical end of the ureter.

E. W. White and R. B. H. Gradwohl in their recent study of vesiculitis say: "A seminal vesicle once invaded by pathogenic organisms soon enters into a state of chronic infiltration due to insufficient drainage. Peri-ureteritis follows from either pressure on the ureter or some interference with the blood and nerve supply to the ureters at this point. The basic cause of urinary complication is indelibly fixed on operating upon these cases of sclerotic vesiculitis. The ureters are easily seen as they run anteriorly to the upper part of the vesicle and not infrequently must be dissected free, due to adhesions and peri-ureteritis and peri-vesiculitis."

In the female, because of different anatomical structures and relations, there is not an immediate possibility of ureteral involvement by an inflammatory process of the adnexa as it occurs in the male; but the frequency of acute and chronic cellulitis and peri-adnexitis around the last ureteral portion makes one wonder why peri-ureteritis should be less common in the female than in the male.

On the other hand, aside from the inflammatory processes so frequent in the female, conditions far more important, that is pregnancy, delivery plus the various accidents of normal or abnormal labor, may possibly damage the anatomical and functional conditions of the intraligamentous portion of the ureter. So, once a cicatricial plastic lesion on the adventitia of the last portion of the ureter is established, especially in cases of multiple and vast lacerations of the cervix, the impairment of ureteral peristalsis on that point is an admitted possibility. It may either come by the partial destruction of the nervous elements or by the direct degenerative changes which must take place in the muscular fibers of the ureteral walls. As for the nervous fibers and ganglia, we know from the researches of Satani that "at the lower end especially there can be observed microscopically a very strong plexus consisting of big nerve fibers with ganglia." "The network of the nerve fibers has quite large, rhomboid meshes, which are placed parallel to the ureteral axis, and grow thicker toward the inner side making a well developed network between the outer fibrous and muscle layers. Some of these nerve fibers enter apparently in between the outer longitudinal muscle fibers. They are composed of medullated fibers, chiefly with some of the non-medullated variety." "At the point of division or sometimes in the course of the nerve fibers there are formed many ganglia in the coat." Generally large ganglia containing over a hundred cells are formed only in the lower part of the ureter.

It is clear that a peri-ureteritis originating from a chronic seminal vesiculitis and substantiated by all the pathological possibilities described by White and Gradwohl must, to a great extent, damage the delicate nervous and muscular structures of the lower segment of the ureter. The functional result of all this can only be one: that the ureteral peristalsis in that portion must diminish or disappear entirely giving once more a clinical analogy of Protopopow's experiment. The extension of this peri-ureteric process may go down directly to the vesical opening of the ureter, or as John H. Cunningham affirms, "the inflammatory process (of seminal vesicles) may invade the bladder wall, producing a basal cystitis or trigonitis" which, by involving the ureteral meatus, may easily cause stenosis.

Here we have an atonic or paralytic condition of the vesical end of the ureter plus a stenosis of the ureteral meatus. That is to say, we have all the necessary anatomical and physiological deviations that lead to the formation of ureterocele.[1] In fact close discriminating observations have convinced me that stenosis of the ureteral orifice alone is not a determining factor of ureterocele, otherwise we could not explain why in many cases the meatus is large enough to permit easy sounding and catheterization. Should a meatus of

[1]An objection might arise here and it is this: if ureterocele is to be considered an anatomical or paralytic condition of this segment of ureter, how is it that its orifice remains contracted? In other words, stenosis of the ureteral meatus would seem to be contradictory and inconceivable; but the contradiction is only apparent. In fact what we call the orifice is nothing but a duplication of the bladder mucosa possessing neither muscular nor nervous elements of ureteral origin, therefore, with no contracting power to follow the physiological fate of the palsied ureter. Moreover if we admit that the meatus must have undergone a previous or contemporary stenosis provoked by some inflammatory process with cicatricial regression around its lumen, we will understand that it must act on the sacculated ureter like a purse-string and we will understand why it cannot follow the excursions of the ureterocele. This is a phenomenon which the eye can easily follow. In fact if we watch attentively the ballooning performances of ureterocele we will see that the orifice remains rigid not only during the inflating but also in the deflating phase (Figs. 4 and 5).

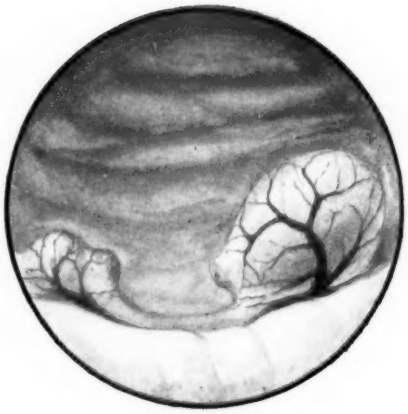


Fig. 1. Case 1.

Fig. 3. Case 3.

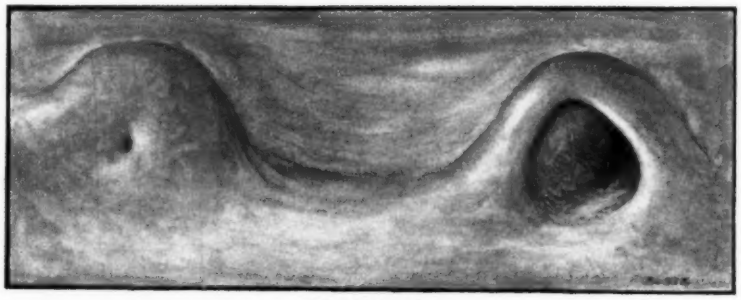


Fig. 2. Case 2.

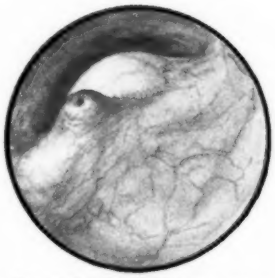


Fig. 4. Case 4, inflating phase.

Fig. 5. Case 4, deflating phase.

Ureterocele; Clinical Significance and Process of Formation.—Diomede Petillo.

this kind be considered the primary cause of ureterocele, before having ureterocele we would have positive unmistakable symptoms of urinary stasis and pelvic dilatation, but this is not the rule. Walker says: "The lumen of the ureter may be narrowed or completely blocked by a valve or congenital stricture. As a result, either hydronephrosis develops or atrophy of the kidney ensues. Rarely the ureter immediately above the stricture dilates without distention of the renal pelvis."

This statement is not only clinically correct but it corresponds also to a postulate of a law of dynamics by virtue of which, if the hydraulic pressure of the urinary mass should increase for some reason (stricture or stenosis of the orifice) to such an extent as to determine dilatation in the pelvi-ureteral tube, the section of this tube which would dilate first and most would be the pelvis: first, because the pelvis is the section of the tube which has a greater circumference with a resulting greater total amount of back pressure; and second, because anatomically the pelvis, compared with the ureter, has a smaller muscular resistance (Testut).

So that if notwithstanding this, the portion of the ureter which dilates is just above the narrowed meatus, or, in other words, the most resistant one, it means that in this very point a pathological condition must exist which lessens its normal resistance, and this condition, which leads directly to ureterocele, is nothing more than an atonic condition.

An equally important reason for discarding the idea that the pathogenesis of ureterocele lies exclusively in the stenotic condition of the meatus is that if we should try to treat ureterocele simply by dilating the ureteral meatus we would meet with the most discouraging failure. This should be decisive, otherwise the clinical principle that cure comes after the removal of the *causa dedecta* would be a fallacious one.

As an illustration of this point I should like to report a case described by A. Hyman:

> The case was that of a young woman who during the previous 6 months had been suffering from acute urinary symptoms (pyuria, lumbar pain, fever, etc.). Cystoscopic examination revealed a left ureterocele with a tiny orifice at the apex. December 19, 1914, the contracted meatus was split with an incisor and a No. 6 catheter inserted and kept *in situ* for 24 hours. Cystoscopy in January, 1915, showed a gaping orifice which easily admitted a No. 6 catheter. The patient was cystoscoped 1 month later; the cystic dilatation had disappeared, the ureteral orifice was patulous and admitted a No. 7 catheter. About 6 months later the patient reappeared complaining of a recurrence of the lumbar pain and cystoscopy demonstrated that contraction and ureterocele had recurred. The patient was again admitted to the hospital for the same condition. Cystoscopy revealed recurring contraction of the orifice with cystic dilatation behind it. The cyst and the meatus were incised several times and a large catheter was inserted for 24 hours. The patient was discharged improved a few weeks later. October, 1917, the patient again consulted mé for a recurrence of her lumbar pain. Cystoscopy again demonstrated a contracted orifice and ureterocele. Utilizing the high frequency spark, the entire cystic wall was cauterized with Oudin current which produced a marked blanching.
>
> Examination 10 days later showed that the necrotic cyst wall had sloughed away, leaving a patulous orifice which was readily cauterized. The patient was seen 5 months later and no appreciable contraction had taken place. The patient has been free of symptoms since the last operation.

The eventful Odyssey of this case is most instructive. It plainly demonstrates that when, notwithstanding repeated splitting of the meatus, so as to admit freely a No. 7 catheter, ureterocele takes place again and again, it is no longer permissible to speak of stenosis of the ureteral orifice as the determining cause of ureterocele. The author seems to give special weight to the "re-contraction" of the splits in trying to explain the recurrence but I think that, from a rigorous physiological point of view, there is no such phenomenon as re-contraction following discontinuity of living tissues. Evidently in his case he meant that despite the splitting, the muscular wall of the ballooning ureterocele remained there just *collapsed;* that is to say, the muscular and elastic fibers of the ureteral wall did not "retract" a bit as usually happens, when the incised tissues are in normal physiological condition. In other words, the splitting gave only a virtual, not an effective dilatation of the meatus, which despite repeated incisions and notwithstanding the continuous gravitation of the urine in the sacculated ureter, remained helplessly refractory to

any active dilatation which would follow except that the conductive faculty of the peristaltic movement of the walls of the ureterocele had entirely disappeared. No wonder then that this patient was cured only after the entire body of the ureterocele had been removed.

A report of my cases follows.

CASE 1. A. S., male, single, came with negative family history. He had never had urinary symptoms previous to the present ones which began 4 years ago when for the first time he contracted an acute gonorrhœa. Two months after date of contagion he began to suffer from acute right epididymitis and from symptoms of acute cystitis. There were slight pollakiuria and urgency, notable dysuria, and morning whitish discharge.

Physical examination showed urine slightly turbid containing small filaments, and the right epididymis indurated. At the rectal exploration the prostate was found almost normal in size but protruding somewhat into the rectum and unusually hard. The seminal vesicles were indurated and nodular. Massage of both prostate and seminal vesicles gave a few drops which showed 10 to 12 pus cells in each microscopic field but no gonococci. At the cysto-urethroscopic examination a bilateral ureterocele was discovered (Fig. 1), the larger one being on the left side. The ureteral meatus on either side was so small that every attempt at catheterization failed. The prostatic urethra appeared greatly congested, the verumontanum globular, prominent, and deeply œdematous, the ejaculatory ducts not visible. The patient had never suffered from lumbar or abdominal pain. A week later both ureteroceles were completely fulgurated and after a few days a systematic gradual dilatation of both ureters was instituted inasmuch as it was evident to me that the intramural portion had undergone a fibrous change resulting in a reduction of the normal caliber.

The urine from both kidneys showed only occasional leucocytes.

CASE 2. A. C., 52, female, married, multipara, was referred by Tresca of New York. For years she had suffered intermittently from genital disturbances culminating in symptoms of pelvic peritonitis. During the last 7 years she had been operated on twice; the first time a curettage was done, the second operation was for probable right salpingectomy.

From the beginning of her genital troubles she had complained of obstinate urinary symptoms: pollakiuria, urgency, dysuria, gradually increasing during the last few months. The surgeons who had treated her told her repeatedly that the uterine and adnexal conditions were responsible for the bladder symptoms, although they never proposed any cystoscopic examination.

At the bimanual exploration the uterus was found notably and abnormally enlarged, ventrofixed and slightly deviated toward the right side. The cervix was big, firm, and uniformly indurated by multiple old lacerations. What was really impressive was that both ureteral ends could be easily touched, being thickened and nodular like those we find in urinary tuberculosis.

Cystoscopic examination gave a very interesting picture of the bladder. The mucosa was *in toto* quite œdematous and translucid, especially on the fundus and trigone. The orifice of the right ureter opened laterally on an unusual type of ureterocele. The ureteral orifice was relatively large and it could easily be entered by a No. 5 catheter, although this would not pass through an obstruction located at a distance of about 2 centimeters. The ureteral opening of the left side appeared even more strikingly peculiar. Here the meatus could not be seen at all, located as it was deep in a cavernous big hole surrounded by a large œdematous ring (Fig. 2). A full sound No. 3 encountered an obstruction, at about the same distance as on the right side, which, however, yielded after several attempts. Both right and left strictures were gradually dilated to permit the introduction of a No. 7 catheter. The urine from the right kidney was quite turbid, microscopical examination of its sediment having proved later to contain a large quantity of epithelium and pus cells. After several periodical catheterizations the urine became clearer and the lumbar pain gradually disappeared. Fulguration of the right ureterocele and treatment of the trigonitis and concomitant urethritis were instituted. On the left side treatment was limited to dilatation of the ureter. The patient was discharged free of symptoms 2 months later.

CASE 3. A. G., 26 years, male, single, two years ago contracted, for the first time, an acute gonorrhœa which had been treated by the usual methods. The only actual complaint of the patient was a burning sensation along the posterior urethra. Had he not intended to marry shortly he would not have come to ask my advice. The external genitalia were normal. The first urine was grossly clear. Rectal examination showed a slightly enlarged prostate and palpable, elongated seminal vesicles, especially the right one, which was abnormally enlarged and tortuous. The second urine, voided after massage of seminal vesicles, was uniformly and deeply turbid and contained large threads. A drop of liquid collected at the meatus during massage showed many pus cells and a few gram negative diplococci.

Cysto-urethroscopic examination showed a typical well vascularized ureterocele on the right side whose ureteral opening, although apparently very small, easily permitted the introduction of the No. 4 catheter. Catheterization of the upper portion of the ureter, however, was not possible owing to the peculiar upward direction of the meatus. By keeping the central end of the catheter in the ballooning cavity the urine would flow freely through it reducing somewhat the size of ureterocele. The prostatic urethra appeared strongly congested and the verumontanum notably œdematous and prominent. By

a gentle digital pressure on seminal vesicles one could see a continuous eructation of purulent débris from both ejaculatory ducts. The ureterocele has been entirely destroyed by fulguration and ureteral catheterization. Sediment from the right urine was negative.

CASE 4. February 8, 1922, P. C., 40, male, married, had had two attacks of gonorrhœa, 12 and 4 years ago.

His actual complaints were a slight sacral pain, dull in character and not clearly localizable; a somewhat frequent urination and a few urinary filaments.

Rectal examination showed quite a large and hard prostate, with the seminal vesicles enormously elongated, firm and nodular. It was not possible to follow and circumscribe their superior limits and the bimanual palpation gave the finger a clear sensation of semi-fluctuation through their thickened walls. A generous massage on both prostate and seminal vesicles gave about 2 cubic centimeters of turbid liquid which under the microscope showed very numerous pus cells but no organism of any kind. The urine immediately voided appeared very turbid, almost muddy. A very long and thick vesicular cast could be easily isolated.

On February 10 cysto-urethroscopy was performed and a peculiar nipple-shaped ureterocele discovered on the left side (Fig. 4) which could be easily catheterized by a No. 3 wired catheter. The collected urine from this side, grossly speaking, appeared to be normal. After centrifugalization there was no appreciable sediment and microscopically there were no morphological elements of any importance with the exception of some occasional erythrocytes evidently of traumatic nature. A fulgurating sound, No. 4, was inserted into the cavity of the ureterocele and it was totally destroyed.

The prostatic urethra showed the usual features of a chronic posterior urethritis with a very much deformed and œdematous verumontanum and several large prostatic ducts opening into the sulci lateralis.

Summing up what I have been saying, ureterocele would be the result of these two conditions: first, a lesion at the end of the extramural portion of the ureter; and second, a more or less narrowed ureteral orifice. The ureteral lesion, either from without (perireteritis, trauma, etc.) or from within (calculus, endo-ureteritis, etc.) acts on the nervous or muscular elements of the ureter with the ultimate result of annihilating or diminishing the ureteral peristalsis in the distal portion so as to give a paralytic or atonic intramural ureter. This, by yielding to the continuous pressure from above and the peripheral resistance from the narrowed meatus, will ultimately dilate. The dilatation should be in inverse proportion to the size of the orifice, or, in other words, greater if the orifice is very narrow, smaller if the meatus is relatively large.

For the sake of clearness I want to represent the formation of ureterocele in a diagram by which, if the conditions mentioned above are acceptable, the whole process will be easily and fully understood (Fig. 8).

The diagram illustrates the behavior of the intramural portion of the ureter in Cases 1 and 3 in which we have a complete ureterocele, that is, a uniform eccentric dilatation of the whole ureteral wall covered internally by ureteral and externally by vesical mucosa and epithelium gradually adapting themselves to this new anatomic condition. Case 3 (Fig. 3) shows a characteristic impressive cystitis with marked thickness of the mucous membrane. This is responsible for what I would call an anomalous ureterocele on the right side; I mean a ureterocele which being covered by an adherent and thickened mucous membrane cannot freely expand and balloon out like the usual type of ureterocele and lacks its transparency. Likewise, on the left side one cannot help thinking that there we have a tentative or abortive type of ureterocele. In fact the massive collar surmounting the meatus is undoubtedly formed by the muscular bundles of longitudinal fibers ending in the interureteric ridge and in the lateral edges of the trigone. Because of the intense regressive cystitis at that point there must have been an infiltration of the areolar layer to an extent not to permit the excursion of the bladder mucosa on the relaxed ureter, so that while the ureteral musculature would tend to lag into the vesical cavity, the mucosa and submucosa would stick firmly to the rest of the bladder wall and consequently the meatus would remain umbilicated in the depth of the cavernous cavity. In a methaphorical way it would be a strait-jacket ureterocele.

Case 4 (Fig. 4) shows also a ureterocele with certain peculiarities worth noting. In fact the inflating phase proves beautifully that ureterocele has developed at the expense of the posterior portion of the ureteral wall only, the anterior wall remaining in perfectly normal condition. This would tend to prove that a ureterocele may affect only part of the

ureter, not a total but a partial ureterocele resulting.

This, in a lesser degree, I have been able to find in quite a few occasional cystoscopic examinations. On the different aspects of the intramural section of the ureter were slight bulgings with the characteristic inflations and deflations of ureterocele. I have records of 2 cases of renal tuberculosis with bladder and ureteral involvement, in which cystoscopic findings of this kind were very evident; but against them I have several other cases (all men) in which chronic gonococcic infection was the etiological factor and adnexal lesions (prostatitis and vesiculitis) the main feature.

As to the treatment, destruction of the ureterocele by fulguration is the method of choice. Ablation through suprapubic cystotomy advocated by several authors is to be considered a surgical abuse, unless for special reasons it should be absolutely necessary.

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HYPERTHYROIDISM AND PEPTIC ULCER—AN ANALOGY

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DESPITE extensive clinical and experimental researches by our ablest surgeons, pathologists and physiologists, the cause of gastric and duodenal ulcer has not been securely established. That the cause of peptic ulcer is not infection alone, nor thrombosis alone, nor hyperacidity alone, nor autodigestion alone is evident from the facts that it occurs more commonly in males than in females; that it is more common in young adult life and in individuals of the worrying or anxious temperament; that it is more common among the more highly civilized races; that it bears no direct relation to diet, for among the masses using similar diet, ulcer still is more commonly the lot of the male than of the female; of the young than of the old.

The incidence of peptic ulcer bears no relation to climatic diseases although the ulcer itself is affected by the season, being worse in winter than in summer. It is affected also by the state of mind, being made worse by worry and anxiety, improved by complacence and a state of negativity.

Who, then, are most disposed to have peptic ulcers? Physicians, lawyers, bankers, business men, individuals who are in the midst of intellectual and emotional stress and also laboring men who work under the constant urge of worry on behalf of their families. Relative immunity appears to be the lot of the improvident and the indolent.

In general, then, the derelicts and both the domestic as well as wild animals, carnivorous as well as herbivorous, are free from the incidence of peptic ulcer.

This kinetic aspect of peptic ulcer immediately suggests that most kinetic of diseases, hyperthyroidism, and leads one to press the analogy further in the hope that by such a comparison light may be thrown upon another and more vital problem concerning peptic ulcer which still awaits its final solution, namely the choice of treatment, for up to the present time there is no agreement regarding the preferred method of treatment, whether it should be medical exclusively or surgical exclusively and if surgical what procedure shall be employed.

That peptic ulcer is characterized by the presence of a hypersecretion of the gastric juice is generally acknowledged, although whether or not hyperacidity is a causative factor is questioned by many. Hypersecretion of the thyroid hormone is the central factor, if not the actual cause, of hyperthyroidism.

Although Smithies and others deny the correlation of hyperacidity and ulcer, nevertheless we must agree with Deaver that even if "not all cases of peptic ulcer are associated with hyperacidity the relation between the two is sufficiently frequent to be more than incidental. Whether the hypersecretion when present produces the ulcer, or the ulcer the hypersecretion is still a matter of argument. While the consensus of opinion seems to be that hyperacidity is first present, it nevertheless would seem that the ulcer, once formed, without doubt maintains the hypersecretion, thus creating a vicious circle with its attendant clinical symptoms and pathological manifestations. In other words, hyperacidity prepares the way for the action of whatever secondary factors, usually of an infectious or toxic nature, may be at work in the pathogenesis of chronic peptic ulcer."

Frick and Mann, and Williamson, by clinical observations and by experiment appear to have proved that whatever its causative value, hyperacidity is undoubtedly a concomitant of peptic ulcer; and in his address before the American College of Surgeons in October, 1924, Devine in a valuable discussion of gastric surgery lays strong emphasis upon the primary importance of the acid factor in the initial causation and in recurrences of gastric ulcers. Devine suggests that disturbances of "retention posture, as a result of sympathetic influences, emanating from the strain of modern life, may be the primary alteration of normal physiology—the basis of ulcer. Subgroup (a) would then correspond to an increased function of the sympathetic and to the condition often found associated with gastric ulcer, and subgroup (b) would correspond to a diminished function of the sympathetic or an overacting vagus, and to the pathology associated with duodenal ulcer. In the latter condition the duodenum would be exposed to any injury likely to result from the action of the gastric acidity while the stomach would suffer in the former."

Let us carry further the analogy between hyperacidity and hyperthyroidism. Both elect young adult life; both flourish in the atmosphere of stress and striving; both are induced and are encouraged by overwork, by worry, by focal infection, by auto-intoxication; both are increased by a protein diet; both induce a change of personality; in the presence of each the patient is improved by a holiday with complete change of environment, by the elimination of worry and anxiety; both peptic ulcer and hyperthyroidism tend to chronicity and to relapse; neither is prevalent among inferior races, among the indolent or dullards of higher races or among degenerates, morons, or the insane; both flourish in compelling, ambitious, conscientious personalities; both are prevalent among individuals of keen desires and internal struggle; in general the incidence of both is highest among those individuals of the white race who are carrying the burden of civilization.

In only one characteristic is there an apparent antithesis between hyperthyroidism and hyperacidity—the incidence of hyperthyroidism is approximately four in females to one in males; the incidence of peptic ulcer is approximately four in males to one in females.

To what extent may this analogy between hyperthyroidism and peptic ulcer serve as a guide in the choice of treatment? In both hyperthyroidism and peptic ulcer the results of medical management range from no relief to permanent recovery, the results in the individual cases depending upon the success of the medical advisor in imparting and of the patient in receiving a re-education—a new point of view regarding the management of his life; a new philosophy as well as a sufficient period of rest and a supervised diet.

In both hyperthyroidism and peptic ulcer the results of surgical treatment as of medical treatment range from no relief to permanent recovery. In surgical treatment also the results depend both upon the success of the surgeon in making the correct decision as to the type of operation in the individual case

and in the willingness of the patient to submit not only to the surgical treatment prescribed but also to a strictly controlled regimen of life for a sufficient period after operation.

Just as the thyroid secretion may be restricted by the excision of a sufficient amount of gland, so hyperacidity may be reduced to normal acidity by the excision of a sufficient amount of the acid secreting part of the stomach. In cases of hyperthyroidism, ligations give temporary, sometimes permanent relief. In cases of chronic gastric ulcer, gastro-enterostomy gives temporary, sometimes permanent relief, the establishment of the cure in each case, however, being dependent in part upon the institution and observation of a period of planned rest, diet, and controlled environment. Permanent relief in cases both of peptic ulcer and of hyperthyroidism, however, is achieved only by the actual removal of a sufficient amount of the hypersecreting tissue, the operation being supplemented by the elimination of focal infection and of auto-intoxication and by the establishment of a specially planned hygienic regimen.

This analogy between peptic ulcer and hyperthyroidism is probably not the only analogy that might be described. Since in the animal mechanism each organ bears an essential relation to each other organ it follows that every stimulus that affects the organism as a whole will also affect each organ in a specific manner. In certain instances, however, as in hyperthyroidism and in peptic ulcer the resultant modification of the organ produces results which are especially dramatic.

Another basis for the analogous responses of the thyroid and of the stomach to abnormal kinetic drives, in particular those which are emotional in type, may be found in the fact which has been emphasized in particular by Cannon that emotional stress inhibits gastro-intestinal activity. In agreement with Cannon we found in our laboratory that emotional stress increases the adrenalin output and in more recent researches we have found that whereas adrenalin increases oxidation in the brain it inhibits oxidation in other regions of the body, in particular within the gastro-intestinal tract. To the extent to which gastric and duodenal motility is decreased or inhibited, to that extent will the process of alkalinization of the acid secretion of the stomach be decreased or inhibited. There will result a state of hyperacidity and diminished resistance to, if not direct causation of ulcer formation.

Hyperthyroidism has been all but conquered. It is true that there exists some controversy as to the method of choice for the reduction of the amount of the secreting tissue, whether it is best accomplished by radiation or by surgery; but nevertheless the consensus of opinion is that only by such a reduction can a final cure be effected. No such unanimity of opinion exists regarding the method by which the amount of secreting tissue in the stomach shall be reduced in cases of peptic ulcer. As we have stated, medical treatment alone in certain cases may avail but in general it must be acknowledged that the Sippy treatment alone is but temporizing. As we have stated, in certain cases gastro-enterostomy may give permanent relief but in general, as Moynihan and Devine have stated, the effects of gastro-enterostomy also are but temporizing. Sleeve resection cripples the motility of the stomach. Cauterization substitutes a burn and a scar for the existing ulcer but does not decrease the acid secretion, the cause of the ulcer. In the case of ulcers of the lesser curvature it is difficult to see how pyloroplasty can be more effective than the removal of the thymus in a case of hyperthyroidism. Moreover, in every case of ulcer of the stomach the possible relation of ulcer to cancer must be considered and the method of choice should be one which would avail if the ulcer were actually an initial malignancy.

Moynihan, Finsterer, and Haberer have pointed the way to what, in view of the results and of the analogies which we have drawn above, would appear to be the logical technique for the surgical treatment of stomach ulcer; the resection of half of the stomach including the pylorus for the purpose of reducing hypersecretion just as thyroidectomy is performed to reduce the thyroid secretion.

Moynihan, Finsterer, and Haberer report an immediate mortality of from 2 to 3 per

cent and that by this change of objective, namely, from excision of the lesion, from drainage, from alkalinization, to the fundamental underlying cause of the condition, namely the hypersecretion, their clinical results have been constantly improving. In addition not only does this procedure control the hypersecretion, but it also removes the common site of cancer of the stomach. The wide opening in the jejunum would appear to be an objection to this radical procedure, but this can be overcome by a modification in technique whereby the large opening in the stomach is evenly adjusted to the small opening in the jejunum. The method by which this is accomplished will be shown later by slides.

Balfour has recently reported that "in duodenal ulcer, gastro-enterostomy, combined, when necessary, with excision of ulcer, gives 95 per cent of satisfactory results, and a mortality rate between 1 and 2 per cent; in gastric ulcer, if combined as a routine with cautery or knife excision of the ulcer, 90 per cent satisfactory results and a mortality rate between 2 and 3 per cent, are obtained." Our results compare favorably with these. It may be added that the Finney and Horsley types of operation for duodenal ulcer are even more satisfactory but they carry a slightly higher immediate risk in cases in which the ulcers are extensively adherent. The outstanding problem which baffles both the internist and the surgeon is the marked callous ulcer of the lesser curvature. In these cases we have adopted the following as a routine method of procedure—that any case of gastric ulcer in which a favorable response to 2 weeks of medical treatment is not obtained, be submitted to operation without further delay. Because of the probability of cancer development, the preliminary medical treatment serves to lessen the size of an ulcer and to educate the patient as to the proper diet and routine which will be required for a prolonged period after the operation. Moreover, the preliminary period of medical care and rest lessens the immediate operative risk.

By comparative secretory curves made after gastro-enterostomy, gastrectomy, and partial gastric exclusion, at various distances from the pylorus, Devine has shown that "free acid is lowest in gastrectomy for gastric ulcer while this operation for duodenal ulcer gives a higher but still very low percentage of acid"; that "partial gastric exclusion gives almost the same regurgitation and secretory curves as gastrectomy"; that "the nearer the section of the stomach approaches the pylorus in gastric exclusion the less the regurgitation and the higher the free acid"; and that "in only two cases of gastrectomy was there any evidence that the low acidity was partially due to a slight hyposecretion. This was also shown in one case of extensive partial gastric exclusion."

The analogy to the treatment of hyperthyroidism serves throughout the whole period of surgical management, that is, shock and hæmorrhage are controlled by reinforcing the patient's reserves *in advance of the emergency* by blood transfusions; by the administration of large amounts of water; by morphine and by rest; by a shockless operation under local anæsthesia and nitrous oxid-oxygen analgesia; infection is controlled by the technique and management and by the maintenance of the general resistance.

After the operative treatment of gastric or duodenal ulcer as after the surgical treatment of hyperthyroidism, if any foci of infection remain uncared for they should be eradicated. We have made it a routine procedure to remove the appendix in all operations for peptic ulcer in order to assure the elimination of this possible focus. The teeth, sinuses, and tonsils should be examined and treated as indicated.

The basis for these analogies and for the evolution of the plan of management which has proved effective alike in cases of hyperthyroidism and of peptic ulcer is based upon the experiences of my associates and myself in 6,268 operations upon the thyroid, of which 3,542 were for hyperthyroidism, and 995 operations upon the stomach, of which 498 were for ulcer of the stomach and duodenum and 326 for cancer. We are now studying our experiences in the last series believing that we can develop our plan of management to a point at which the operability and mortality in cases of peptic ulcer will be comparable to the operability and mortality in cases of hyperthyroidism.

CALCIUM[1]

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I AM sure that we are satisfied that we so chose our birthdays as to enable us to live during the last few decades, the most progressive period of the world's history. Truly, this is the age of science, and science is merely a knowledge of the natural laws which are not mysterious, but most simple when understood as chemical, biochemical, physical, and electrophysical phenomena. In all their many variations, these truths have been rapidly unfolded. Opportunity for rapid advancement of science often comes through war. Warfare to destroy life or to preserve and sustain it is part of the eternal struggle for existence. Such warfare always has and always will exist. In general, the greatest destroying enemies of living things are more or less controllable, although invisible. The Great War advanced science along all lines, but the advancement of medical science has been especially appreciated by the public because of the unusual opportunity which the profession had, to apply its knowledge. For the first time in warfare the Army Medical Department was given the responsibility and authority for prevention of disease. The various branches of science are associated, discoveries in one branch becoming the tools of many willing workers in others. Man first called to his aid the winds, for sailboats and mill wheels. Then came water-power. Later came a recognition of the value of coal and oil, the stored energy of our sun in past ages. Progress is now being made in the control of electricity, which new developments show to be fundamental. The enormous world of our forefathers is now as much smaller, as the rapidity of travel on land and sea has increased since their time. Our birdmen have conquered the air, and the couplet in Mother Shipman's 300-year old prophesy has come true: "Thoughts around the world will fly in the twinkling of an eye." The various peoples in the world are naturally more and more interested in the lives, industries, character, and honesty of neighboring nations. The more highly civilized people are interested in the prevention of contagious disease, affecting not only plants and animals, but also human life. Every nation has its percentage of criminals, and also a greater number of potential criminals who need but opportunity or leadership. The world needs a League Court where nations may complain as individuals to world court judges with authority to investigate and to give publicity. Our great national danger, however, is not from enemies without, but from those within our country who pass as citizens.

With the comparative shrinkage of the world, a greater interest is aroused in its structure. There are but a few elements undiscovered among the ninety-two essential elements in its makeup, and from those already known, thousands of combinations have been created.

The modern physicist maintains that all nature is electric in varying degrees of activity, atomic weight merely representing the number of electrons held together, and that the structural atom of the essential elements is composed of a solar system, consisting of a bundle of positive electrons as a nucleus or sun with negative electrons moving about it with intense rapidity. These range from one positive and one negative electron or planet in hydrogen, to ninety-two in uranium. Each known element drops into its respective position in the scale, according to the number of balanced positive and negative electrons. Only a few years ago scientists would not accept the idea of transmutation of elements; today it is proved and accepted. It may be difficult in some elements for the positive nucleus group to control the negative electrons, an example of natural politics. One may occasionally fly off, like a comet or meteor, and change its original material; thus helium gas, and A, B, and C radium are derived from uranium, and ultimately lead is formed from radium. With the α-ray to bombard nitrogen, a trace of hydrogen is created.

Scientific medicine had made marvelous progress during the last few decades, in fact more than in all its previous history, from the application of principles revealed by investigators of a few decades earlier. The microscope made possible the study and appreciation of the normal and diseased tissue cells; today the ultramicroscope permits the study of the individual cell, and physiology of function is now discussed in terms of chemistry.

Both plant and animal life require but fourteen of the elements; these include the common gases: nitrogen, hydrogen, oxygen, carbon, and also calcium, and chlorine, iron, magnesia, phosphorus, potassium, silicon, soda, sulphur, and iodine, although but a minute particle of the latter is required for the normal function of the thyroid.

[1] Presidential address before Clinical Congress of the American College of Surgeons, New York, October 20, 1924.

Plummer has shown that the thyroid renders the energy of the body cells available for use, just as potassium makes growth possible in certain plants when combined with chlorophyl and sunlight. Man becomes greatly cheapened when considered as associated elements in combination, and while he may be of no value or of very great value above his neck, his labor is worth but union wage, and he often puts into his stomach in one meal much more than the value of his entire carcass, which was estimated in war time high prices at approximately 98 cents, or the value of seven bars of soap, enough sugar to fill a shaker, sufficient iron to make an eight-penny nail, potassium enough for one explosive cap, enough lime to whitewash a chicken coop, sulphur enough to take the fleas off a dog, enough magnesia to make one dose to relieve a sour stomach, and enough phosphorus to cover the heads of 2,200 matches. It is unfortunate, indeed it is sheer waste in this, the nicotine age, that man cannot generate a self-lighter for cigarettes.

Nearly 99 per cent of the world consists of but eight of the elements and their combinations; oxygen, free or combined, accounts for almost 50 per cent of the world, and silicon for 28 per cent.

The essential elements for plants and man are found in ordinary soil, and by constant cropping without fertilizing or renewal, one or more may become exhausted; it is stated that this occasioned the abandoning of 13,000 farms in New England. In man the blood stream is a movable soil containing all the elements necessary for building the body and maintaining repair and nutrition, the materials being daily replenished by food. Our blood is our inheritance, its ability permanently to maintain an almost exact proportion of its minerals means stability or strength to resist the ordinary diseases to which we are exposed during life, and heredity means much in determining the prospects and degree of recovery of a sick individual. The day finally comes to all persons when there is a break in health; this may be at an early age, or more commonly between forty and sixty years, at which time they tend to develop disease common to their relatives, such as rheumatism, heart disease, or affections of the circulation or nervous system. Associated with the direct infective agent is the indirect one of a change in one or more of the elements of the blood, and a lowering of resistance. Calcium and magnesium work in harmony and maintain the slight alkalinity normal to body fluids; they exchange with sodium as an interchangeable base. Potassium and sodium in excess are irritants to the nervous system.

Today we are interested in calcium. This mineral constitutes 3.5 per cent of the earth; it is held in solution in fresh water and in sea water; long ago it was more dense in sea water than now. It was formed into calcium mud in layers in the Cambrian period of the world's history, being deposited through chemical action of at least five kinds of algæ and other allied bacteria like the denitrifying bacteria of sea and soil, and chain streptococci. The most common organisms in the sea today are the bacterium calcis of Drew, and pseudomonas calcis of Kellerman and Smith, which, when associated with the proper physiochemical conditions, sunlight being essential, are causing a deposit of calcium mud about the shores of Florida, the Bahamas, and Australia, and also about coral islands. In the limestone we find the pre-Cambrian and Cambrian invertebrate life lost in the soft calcium mud before it solidified, becoming fossils from molecular replacement of tissue cells with minerals. The layers of stone meant cessation of bacterial function for temporary periods, caused by muddy water, or change of temperature; and changes of density of calcium in solution all alike caused variations in the thickness of layers of limestone or soil, and age periods or changes of position following earthquakes gave opportunity for other minerals between the beds of limestone.

Carbonate of lime is thrown down from colloidal conditions bacterially created, the carbon necessary being formed from decay of organic matter, the physiochemical condition necessary for deposit being the action of living cells in single or multicellular organic life. Great areas of carbonate of lime are found in the chalk cliffs, the result of minute shell deposits of early sea life, and today from sea water and river water, mollusks separate colloidal mucus-holding lime in suspension, but microbic life is also employed in shell building, and a few workmen misplaced into the interior structure of some mollusks in fresh or sea water develop the pearls, which may vary in color and shape, but are as essentially a disease as is stone in the kidney. Carbonate of lime is formed in great quantity by the laying hen, which, each day for weeks at a time, is able to develop a heavy egg shell from the colloid lime thrown out in the oviduct, while animals which lose their horns yearly, like the deer and the elk, are able to grow new horns in the velvet, weighing from 10 to 50 pounds, in approximately 100 days. Such animals are naturally leaf eaters, and do not have a gall bladder. Sunlight acts on chlorophyl, potassium and iron in the leaf, and builds plant life, just as it acts on hæmoglobin, potassium and

iron in the red blood cell and builds animal life. This is why the medical profession is in favor of daylight-saving. Calcium is present and remains in the leaves when they drop in the fall, but the potassium passes back into the plant or tree structure. Great beds, 2 to 4 feet thick, rich in calcium phosphate and used for soil fertilizers, are found throughout the world where the bone deposits of countless numbers of the ancient animals of the sea accumulated. In this country these deposits are in Florida, Georgia, and South Carolina. Congress should pass a law to prevent the shipment out of this country of a great natural resource which will soon be needed to restore our exhausted soils, with a great population to support.

Calcium is deposited in bones by cell action, and the lime will be comparatively quickly removed near injured bone or infected bone areas, or again it may be deposited in increased density as a protecting wall close to areas of infection. It is found in senile ovaries, and in the walls of infected cavities, in chronic disease of heart valves and diseased walls of blood vessels. It is deposited in true bone formation only in vascular tissues, at times in the thyroid in cases of colloid goiter, but not as bone in the walls of infected cavities; its deposit in bone, and the growth of bone are largely controlled by the function of the thyroid gland in association with the pituitary in early animal life. It exists in the blood under normal conditions as calcium bicarbonate and dicalcium phosphate in the proportion of 10.5 milligrams to each 100 cubic centimeters of blood; a small part of this, varying in amount according to the state of health of different individuals, is present but not available for use as combined calcium, and is found bound in the blood clot with thrombin and fibrogen to reappear in the blood serum. The remainder, the ionic calcium, is rarely below 9 milligrams in health, and is the free available calcium.

Blood calcium is possibly largely controlled by the action of parathyroid glands; if they are injured at birth by internal hæmorrhage, the child may develop tetany at the end of 3 months, the nervous system being protected at birth and in the interval by the excess of calcium in the brain and nervous system over that in the bone, nature using the calcium as a protector and as a buffer. Reduction of calcium leaves the nervous system exposed, and tetany appears as the lime passes to the bone. The loss of parathyroids leads to great elimination of calcium by the urine and by the intestines, and when the percentage of calcium is reduced below 7 milligrams for each 100 cubic centimeters of blood, tetany supervenes and guanidin toxins are found in the blood. To read the therapeutic literature, popular because distributed free by those interested in the sale of the remedy, it would appear that parathyroid extract must be given and is effective in raising the blood calcium; while this is theoretically true, the remedy is far from being sufficiently worked out and standardized for administration by the laity, who desire statements of fact, dosage, and rules, not having knowledge to form judgment.

Calcium injected into the blood is rapidly eliminated, and in a few days, it is down to the previous standard. Calcium in excess injected into tissues, as into the peritoneum, is quickly transferred to the intercellular spaces of organs and glands. In the control of hæmorrhage in jaundice, when operation is essential, calcium chloride may be administered by Walter's method, giving 5 cubic centimeters of a 10 per cent solution of chloride of calcium intravenously, once a day for 3 days preceding operation, a coagulation time of from 12 to 20 minutes being then reduced to from 5 to 7 minutes. Calcium may later replace the fatty degeneration which is the first change found in regressive glandular tuberculosis. It is found lining old infected cavities of the lung and abdomen; it is found in the blood vessels. It may have to do with colloidal density of blood in some cases of hypertension. Chemical calcium removers, such as are used in popular water softeners, illustrate the fact that calcium may take the place of sodium, or sodium of calcium, as interchangeable bases. In some cases of nephritic œdema with sodium in excess, the giving of chloride of calcium by mouth will relieve the œdema in 48 hours, and renal function be greatly increased. Magnesia in small doses, two or three times weekly, is sometimes given to prevent re-formation of stone in the kidney and ureter. In rickets, an acid condition exists and there is an excess of calcium in solution. In tetany an alkalinity exists and lime is eliminated.

I still believe, as I suggested at the Clinical Congress of Surgeons of North America in Boston, in 1915, that stone in the kidney is undoubtedly due to direct bacterial formation, the same as mollusk shell from the lime of colloid. In the kidney, two types of bacteria are required, one creating colloids or mucus from local injury, and one, the stone-forming microbe. Reproduction of human conditions in the mouth of animals by creating foci of infection in crowned teeth with the bacteria sedimented from the renal secretion of persons with stone in the kidney, will cause alveolar root abscesses within 3 months, and a few months later, free stones in the renal pelvis

in 66 per cent of the animals, and in a greater number (86 per cent) calcium deposit is also found in the medulla of the kidney. Only a small part of the lime which we see in the world is deposited by physical or chemical conditions or oversaturated solutions, by evaporation or heat alone. Practically all of it that we see: various limestone layers, chalk, marble, or gypsum; also that combined with magnesium carbonate; lime in bone cells or mollusk shells, or abnormally formed stones in the kidney, urinary bladder, or gallbladder, excepting pure cholesterin stones, should call our attention to one thing, that it is the product of cell action.

The world is in need of investigators on fundamental questions of soil, such as the chemistry of the blood, as never before in man's progress. Today we have the tools to work with, but lack the general knowledge to use them. We need and will soon have far simpler methods of investigation. Who will enter the Hall of Fame by developing such methods?

MASSIVE TUMORS DUE TO DIVERTICULITIS OF THE LARGE BOWEL

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IT is generally recognized that tumors of considerable size may result from inflammatory reaction in connection with diverticulitis of the large bowel. In 1911[1] I published a series of cases of "Inflammatory Tumors Producing Intestinal Obstruction": I wish to refer to two of those cases because in both instances tumors of extraordinarily large size disappeared spontaneously and, after the lapse of 15 years both patients are alive and well. They have never suffered any recurrence of the trouble and they continue to enjoy good health. The cases are as follows:

Case 1. W. D., age 47, male, presented himself in November, 1910, with a tumor in the pelvis, involving the rectum and lower sigmoid flexure of the colon. He had complained of progressive difficulty in getting the bowels to move for 4 months prior to consultation with me. When I saw him first with Dr. Meldrum, of New Durham, obstruction was almost complete, he suffered much pain after taking food, he had occasional attacks of vomiting and after free purgation had passed fluid fæces only. He had never passed blood or mucus. He had lost 15 or 20 pounds in weight. On examination there was some abdominal distention, but, in spite of this, a tumor was easily palpable in the left iliac fossa. Per rectum a mass was found filling the pelvis. His temperature was 101° F., pulse 92, and the white blood count was 20,400 per cubic millimeter.

On opening the abdomen in the middle line one found a mass in which the sigmoid and rectum were embedded (Fig. 1). Finding a line of cleavage, the tumor was separated from the pelvic wall on the left side. The terminal portion of the appendix was embedded in this mass. The appendix was removed and an attempt was made to perform an inguinal colostomy, but as the available portion of the sigmoid was unusually short and there was no sigmoid mesentery, the bowel was divided transversely and a Paul's tube secured in either end. He made a good recovery with a fæcal fistula. Three weeks subsequently a portion of the mass was removed by operation through the rectum. This was found histologically to be purely inflammatory in character. Eight weeks after the first operation it was found possible to pass a No. 10, English catheter from the lower sigmoid opening down through the anus, the distance by measurement between the two openings being exactly 12 inches. He returned to his farm in the country and came back greatly improved in health and it was now found, 3½ months after performing colostomy, that the tumor had largely disappeared. A large rectal bougie 1 inch in diameter was passed through the lower segment of the bowel without difficulty; then an end-to-end anastomosis was established at the seat of the colostomy operation. This was very readily accomplished over a rubber tube as recommended by Balfour. He made an uninterrupted recovery and has remained in perfect health. The man is a farmer and has worked continuously on his farm since the operation 15 years ago. He is now 62 years of age and is still active.

Case 2. E. B., age 22, female, consulted the writer in November, 1910, because of a tumor resembling sarcoma firmly attached to bone in the left iliac fossa. She had the appendix removed for acute infection 5 months previously. She discovered the tumor 3 weeks before she came under observation. There was a slowly progressive

[1]Inflammatory tumors producing intestinal obstruction. Interst. M. J., 1911, xviii, Nov. 9.

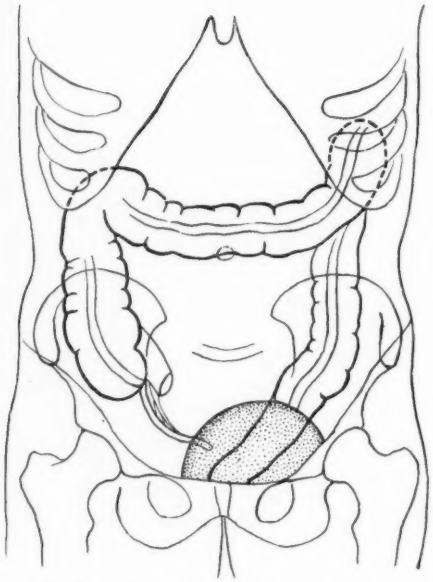

Fig. 1. Inflammatory tumor involving the rectosigmoid portion of the large bowel and causing obstruction. (Reproduced from former paper.)

difficulty in getting the bowels to move. An ovoid mass regular in outline and firmly connected with the iliac bone extended upward and inward within 2 inches of the navel (Fig. 2). It was tender on pressure but no fluctuation could be detected. The temperature ranged from 99 to 100 F., pulse 80, the leucocyte count showed 18,000 white cells per cubic millimeter. The X-ray picture revealed a blurring in the region of the tumor but nothing more. She had lost weight to a considerable degree.

On opening the abdomen the mass was found fixed to the bone in the left iliac fossa. Finding a line of cleavage it was separated from the bone and was then found to involve the sigmoid colon. It was also intimately adherent to the left broad ligament and the uterus. A portion of the tumor the size of a golf ball was removed. This left a raw bleeding cavity which was packed with gauze. Histologically the mass was found to consist of inflammatory tissue solely: there was no localized collection of pus but numerous pus cells were distributed in the tissue. Subsequent to the operation she developed a fæcal fistula connected with the sigmoid flexure. This closed spontaneously and all trace of the tumor slowly disappeared so that she was perfectly well 4 months after operation.

This patient subsequently married and has two healthy children. She is now 37 years of age and has enjoyed perfect health since the operation 15 years ago.

At the time I published my paper on inflammatory tumors of the large bowel I did not determine the etiological factor in their production. From the experience I have had in recent years I am convinced that diverticulitis is the primary cause of such growths, even when of unusually large size. The interesting fact is that under favorable conditions they are capable of disappearing spontaneously. The conditions favorable to their disappearance appear to be provided when the bowel is opened above the obstruction and an artificial anus established. Furthermore if the fæcal fistula is closed too early the tumor tends to recur as illustrated by the following example:

CASE 3. Capt. B., aged 22, male. On September 16, 1918, Major George Wilson operated upon him at Camp Borden and removed a gangrenous appendix. Subsequent to operation he suffered abdominal distress and on October 4, 1918 (18 days after operation) he was admitted to the Toronto General Hospital suffering from acute obstruction. He was subjected to immediate operation: one found general peritonitis, the entire serosa being acutely congested: the lower 2 or 3 feet of the ileum were distended as well as the entire large bowel. A loop of distended ileum was firmly fixed by adhesions to the lower sigmoid in the pelvis. The sigmoid flexure itself was greatly distended. One freed the loop of ileum from the pelvis and in doing so a stinking abscess was opened in the rectovesical pouch. At the rectosigmoid juncture was a tumor mass. It was considered to be a case of diverticulitis causing obstruction. The patient's condition was desperate and a colostomy was done in the upper portion of the sigmoid flexure.

On November 27, 1918, having found the lower bowel patent by X-ray examination after administering a barium enema, the colostomy was closed.

On March 8, 1919, symptoms of obstruction recurred; this was not absolute. Flatus passed readily but it was difficult to get a movement. A tumor was palpable near the left anterosuperior iliac spine. The abdomen was opened, a hard mass was found in the lower sigmoid firmly adherent to the anterior abdominal wall and to the back of the bladder. Sigmoid colostomy was performed for the second time.

On November 10, 1919 (8 months after the last operation), one found the tumor had entirely disappeared. A barium enema followed by X-ray examination showed the passage free from obstruction. The colostomy was therefore closed a second time by Coffey's method.

The patient has enjoyed full health since the last operation which was performed more than six years ago.

Occasionally the tumors are multiple and yet are amenable to similar treatment as in the following case where a cæcostomy was kept open for a year and then closed. Four years subsequent to operation the patient remains well and free from all trouble.

CASE 4. R. H., aged 56, male, came under observation in August, 1920, with symptoms of bladder trouble: suffering pain and frequency of micturition. For 12 months he had complained of pain on the left side: Ten days prior to consultation he had blood and mucus in the stool. Blood had only been noticed on one occasion. He had incomplete obstruction but no vomiting. He had lost weight. There was marked tenderness on pressure in the left iliac fossa. On April 6, 1921, an X-ray series showed retention in the appendix and a filling defect in the iliac colon. A tentative diagnosis was suggested of extensive diverticulitis.

On April 18, 1921, laparotomy was performed. A tumor was found in the lower end of the iliac colon, hard, firm but not nodular: it was firmly fixed: 7 inches higher up a second growth was found in the descending colon, about half the size of the lower growth: this was also fixed. The appendices epiploicæ were loaded with fat. The liver was normal. There was no lymph glandular involvement. On the anterior surface of the sigmoid flexure, 2 inches above the lower growth was an elevated plaque, oval in shape, 1 centimeter long, 0.5 centimeter wide, dirty white in color and elevated 6 millimeters above the surface. It looked like a secondary manifestation of cancer. It was excised. Microscopic examination afterward showed it to be a small diverticulum with chronic inflammatory thickening about it, with great increase in round cells and fibrous tissue. An adherent appendix was removed and a cæcal colostomy established. An X-ray examination after barium enema on May 26, 1921, showed a filling defect in the mid-sigmoid. A similar examination on June 11, after a barium meal showed a diverticulitis of the pelvic colon. The patient was extremely neurotic. Daily irrigations from rectum to cæcal anus were carried out with castile soap followed by clear water, for 8 months. On April 18, 1922, the colostomy opening was closed and at the same time a large cæcal hernia, which had developed, was repaired.

The patient has had no further trouble and continues to enjoy good health four years after the primary operation.

I do not advocate this method of treatment in all cases. I have found the Mikulicz operation most satisfactory in cases of diverticulitis of the sigmoid with obstruction. In such cases it is possible to bring out the loop and to excise the affected portion of bowel with subsequent closure of the fæcal fistula. This, no doubt, is the ideal method of treatment in suitable cases, particularly in view of the fact that cancer is sometimes engrafted upon a diverticulitis. Masson reports from the Mayo Clinic that 14.65 per cent of a series of 116 patients operated on for diverticulitis showed malignant changes at the time of operation.[1] Nevertheless conditions arise in which it is impossible to perform a Mikulicz operation as illustrated in the cases reported above. Therefore, it becomes a matter of great interest to recognize that such growths, even massive tumors, may disappear spontaneously after the simple expedient of establishing an artificial anus and that a permanent cure may result therefrom.

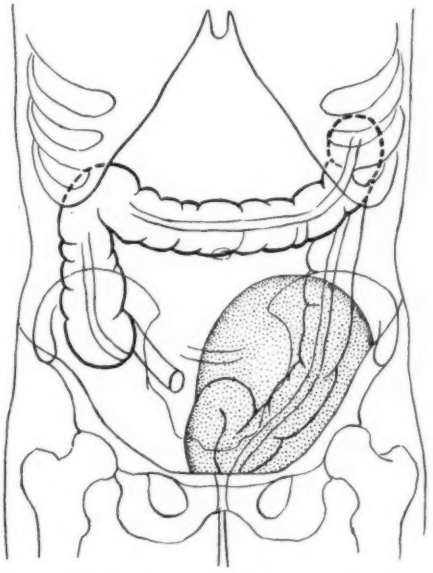

Fig. 2. Inflammatory tumor adherent to bone in the iliac fossa and involving the sigmoid flexure of the colon. (Reproduced from former paper.)

[1]Diverticulitis of the large bowel. Collected Papers of the Mayo Clinic, 1921, vol. xiii, 221.

PERIARTERIAL SYMPATHECTOMY; INDICATIONS FOR ITS USE IN CIRCULATORY DISEASES OF THE EXTREMITIES[1]

By BERTRAM M. BERNHEIM, M.D., F.A.C.S., Baltimore, Maryland

THE sympathetic nervous system, for the most part, is made up of such a vague network of filaments that it has been singularly free from surgical attack. Physiologists have long been familiar with its importance and have repeatedly called attention to it, but the very evasiveness of its ramifications has acted as a screen to its activities and a protecting shield against interference.

Upon occasion the suggestion has been made that relief from certain ills was to be had by the section or removal of certain sympathetic ganglia or trunks, and operations with that end in view have been carried out—successful operations, too, both in regard to relief obtained and to promise of future advances along similar lines. As so often happens, though, theory was in advance of practice and these operations proved to be hardly more than abortive gestures. The surgical world was not ready to consider the sympathetic nervous system as an avenue of attack in the struggle against human ills.

Things are different now—or appear to be. Whether the older leads have been exhausted or whether the desire to explore new territories is the cause, the fact remains that there is not only the readiness, there is an eagerness to take up the cudgels against the sympathetic nervous system, and surgeons are keenly alive to the possibilities of the situation.

It must be admitted at the start that our knowledge concerning the activities of these nerves is none too deep. Whether the nerves themselves are hyperactive by reason of some vague central nervous instability, or whether the tissues are primarily responsible and react upon the nerves—chemically, perhaps, or through the toxic products of faulty metabolism—has not been made clear, but in any case the underlying operative idea in each instance is to eliminate existing sympathetic nerve control by section or extirpation. This applies in the case of blood vessels as well as in the case of muscles and other tissues. The sympathetic nerves appear to exercise an influence of such character that a spastic condition of the tissues to which they are distributed results, or the tissues themselves, hyperspastic primarily, cannot relax in the presence of sympathetic nerve control. In either case, removal of these intangible impulses permits of a return to normalcy. Such, in brief, is the theory. In certain cases of angina pectoris, extirpation of the superior cervical ganglion relieves the painful attacks. In Little's disease (cerebral spastic palsy) the removal of certain sympathetic ganglia in the retroperitoneal lumbar region is suggested, while certain circulatory disorders of the extremities appear to be relieved by section of the sympathetic nerves found in the adventitial sheath of the major blood vessels. This may be but the beginning.

Periarterial sympathectomy was first suggested by Jaboulay in 1889, but it was his pupil, the brilliant Leriche of Lyons, France, who gave it prominence. Leriche suggested, in 1913, that the operation might be of considerable value in vasomotor and so-called trophic disturbances of the extremities, and his published case reports were convincing. Since that time he has performed the operation many times and for quite a heterogenous group of conditions, some of which seem to have been benefited more than others. Some of his cases appear to have improved or recovered in spite of the operation, rather than because of it; in a certain few it would appear that sympathectomy was a heroic procedure to say the least, while its rationale in others was certainly far-fetched—one might even say it was unnecessary or inadvisable since conservative measures might have accomplished more.

One thing stands out clearly. Striking results were obtained in ischæmic disturbances of the extremities, conditions in which there was a vascular disorder depending upon a spasmodic condition of the blood vessels—the

[1]Read before the Clinical Congress of American College of Surgeons, New York, October, 1924.

so-called Raynaud type of disease. This attracted considerable attention in this country, chiefly because Raynaud's disease and certain other allied conditions are rather common and have not been particularly amenable to other forms of treatment, operative or non-operative. As a result, a renewed interest has been aroused in the treatment of the various painful blood vessel disorders of the extremities, an interest that has lain dormant since the days of the arteriovenous anastomosis, or reversal of the circulation, some 10 or more years ago.

This procedure, as will be recalled, gave rise to a lively discussion and much speculation both as to its feasibility and as to its value in the treatment of the painful vascular disorders of the extremities for the relief of which it was suggested. A number of the operations were done, I did some fifteen of them myself and without operative mortality, but the procedure was gradually abandoned as a surgical entity, chiefly if not entirely because the vessels to be worked with were thickened by wear and tear and disease to such extent that they were not amenable to successful suture. More often than not a clot formed at the suture line, not at once, perhaps, but in most cases later on.

There were certain features of that old operation, though, that intrigued one's imagination to say the least, and only now does the true explanation appear. I might even advance the suggestion that quite subconsciously, perhaps, Jaboulay arrived at his conception of periarterial sympathectomy by the arteriovenous anastomosis route, since he was actively interested in the blood vessel suture years ago, even to the extent of himself doing an occasional arteriovenous anastomosis for threatened or real gangrene. Whether he did or not is, of course, beside the question, but the fact remains that many of the patients who were subjected to an arteriovenous anastomosis were considerably improved, both in regard to relief of pain and improvement in the circulation of the affected limb, even when the operation was a technical failure.

It is plainly to be seen now that this relief was solely due to the periarterial sympathectomy that was done in the course of the operation, meticulous removal of the adventitia being the very first step, one might even say the most important one of all, not only in this operation but in any vascular suture. Thus we were very close to the periarterial sympathectomy quite some years ago, and it is reasonable to suppose that our unfamiliarity with the sympathetic nervous system, together with its intangibility, prevented us from realizing our proximity. That the fog was penetrated stands to Jaboulay's credit, and to that of Leriche.

Just what the final place of periarterial sympathectomy as a surgical procedure will be it is impossible at this time to say, and whether anyone or everyone should do it is also of some question. One cannot help but feel, though, that any surgeon of experience is qualified to do this operation provided he handles the vessel with delicacy and takes his time. This is especially to be emphasized in the case of those who have never done any of the finer blood vessel work, since rough handling, too much hurry, and a general disregard of the tissues under consideration will surely prove disastrous. I have knowledge of one instance (personal communication) in which the femoral artery was accidentally torn and immediate amputation had to be done, while in one of my own cases, despite great care, a posterior muscular branch tore off flush with the arterial wall, giving rise to severe bleeding and necessitating an arterial suture. It is not the simple operation some men think it is, and it is not devoid of danger. No operation that has to do with the larger arterial trunks can be called a simple affair, and there are always real possibilities connected with the handling of such vessels.

According to Leriche, about 2 inches (5 centimeters) of the artery should be denuded and the best place is well up in Scarpa's triangle in the leg, starting below the profunda vessels and working downward, and just below the axilla in the arm. Coming down on the vessels one first makes a longitudinal slit through the enveloping sheath (Fig. 1) of the vessels, exposing the artery for a distance of 3 or 4 inches. It is then advisable to pass a tape (Fig. 2) around the vessel at each end of the incision for purposes of lifting the vessel

with the least trauma and for the control of any accidental hæmorrhage that might occur. Following this step every branch that comes off from the artery, large and small, should be caught, tied, and cut between two ligatures, thus allowing the vessel to be lifted out of its bed and twisted and turned at will.

If at this point a little warm salt solution is gently dropped on the artery, its outer coat will take on a whitish, cotton-like appearance and will stand out clearly. With the finger one can feel how freely movable it is on the firmer coat beneath. If one grasps a nip of it with a mouse-toothed forceps (Fig. 3), he will find that it can be lifted away from the underlying coat and cut with the points of a pair of scissors. Release of the forceps will now reveal a small, round opening in the adventitia into which (Figs. 4 and 5) the ends of a straight clamp can be introduced. The jaws of this clamp, which is held parallel to, and flat on the artery, are gently opened, the blunt end of a scissors is introduced between them (Fig. 6), and the two instruments following up the course of the vessel, a longitudinal cut of the desired length is carefully made in the coat under consideration.

At this point the edges of the adventitia are grasped on either side of the incision with straight clamps (Fig. 7), and by means of scissors, knife, blunt dissector, or all three, dissected back on either side. The clamps on one side are then removed, whereupon, by rotating the artery (Fig. 8), it is possible to dissect off the adventitia *in toto*. It is a little difficult and at times trying to obtain a complete removal around the various arterial branches, but by persevering and occasionally by snipping an extra hole in the coat to one side of these vessels it can be peeled off completely and without doing damage. Some men prefer to ligate these branches after the adventitia has been removed, and this plan has certain advantages. But the best results, I think, are had when the branches are tied first, because this gives one a vessel that can be freely and easily worked with. The danger is less, too, because some of the branches are quite small, and if they are left attached the various manipulations to which the artery is necessarily subjected are liable to tear them loose.

In some cases the adventitia seems to be in two fairly distinct layers, and it is there that the difficulty lies. When the first or main layer has been removed in the manner outlined, the vessel should again be soaked in warm saline solution. If any more adventitia remains it will manifest itself as a filmy, cotton-like network, not so prominent as the first coat but rather definite none the less. It is to be removed exactly as was the first coat, and when this is finished, the vessel is to be thoroughly inspected once more for further evidence of adventitia. There will always be a few isolated fibers remaining but if one has been careful and skillful, at the conclusion of his labors he will have left a vessel somewhat contracted, whose wall, smooth and glistening, is considerably thinner at the site of operation than above and below. In some cases it is even possible to see the blood flowing within. At the conclusion of the operation a nick is made in the adventitia (Fig. 9) at either end of the denuded area to avoid any constriction that might arise at these points because the adventitia rolls up there.

The operation is singularly devoid of bleeding and it is not so difficult once it is under way. In some cases a considerable amount of scar tissue will be found around the artery much as if at some time a hæmorrhage had taken place. The adventitia in these cases is thicker and peels off more as an actual coat but with more difficulty. The danger of tearing into the muscular coat is greater here, too. But I am led to believe that the chief thing to be feared is an incomplete adventitial removal, and further that certain of the poor results already obtained, together with some of the failures of the future, can be laid to this cause. Such a case has come to my attention just recently. It is just a little hectic to remove the adventitial coat from a live artery, and at its conclusion the vessel wall looks so thin that one hates to go back for more for fear of doing damage. At the conclusion of the operation the artery is dropped back in its bed, and the surrounding structures are permitted to fall back in place. No sutures of any kind that might be of a constricting nature are placed. Only the overlying muscle fascia, the subcutaneous fascia, and the skin are sutured.

Indications for this operation have not thus far been made clear. I never knew how many painful amputation stumps there were until I began to hear of periarterial sympathectomy, and as for the trophoneuroses, trophœdemata, and causalgias, the literature of this subject almost gives the impression that they are the commonest of ills. One hates to be too critical but the thought does occur that a better appreciation of the principles and applications of general surgery will do much more good in many of these conditions than such a technical affair as periarterial sympathectomy. If there is a painful neuroma it were best removed; if a nerve is caught in scar-tissue it were best dissected free; if amputation has been done below the knee in a case of blood vessel disease a mistake has been made and one ought not to resort to decapsulation of the artery high up to correct it. Amputation should be done above the knee in these cases. Then the stumps will not be painful, proper healing will take place, and there will be no ulcers. In any case, the field for sympathectomy in this type of case should be decidedly limited.

As for the rarer conditions of trophoneuroses, trophœdemata, causalgias, and the like, most of them have followed wounds of one sort or another, whether incurred during the late war or accidentally in civil life, and are at best not of wide interest. Leriche himself, in speaking of trophic troubles, says: "Relapse is possible if the cause of the trophic trouble has not been removed, and the cause is not always removed by the sympathectomy. . . . I believe sympathectomy should be replaced here by the removal of the neuroma of the sectioned nerve, which is the starting point of the vasomotor reflexes causing the trophic trouble. The removal of the neuroma must be followed by the reconstitution of the continuity of the nerve, either by suture or by grafts, avoiding thus the recurrence of the neuroma. I performed seven grafts with complete satisfaction and now prefer this method to sympathectomy in spite of its satisfactory results." In other words, the application of general surgical principles gives results which are far preferable to those obtained with arterial decapsulation in such cases.

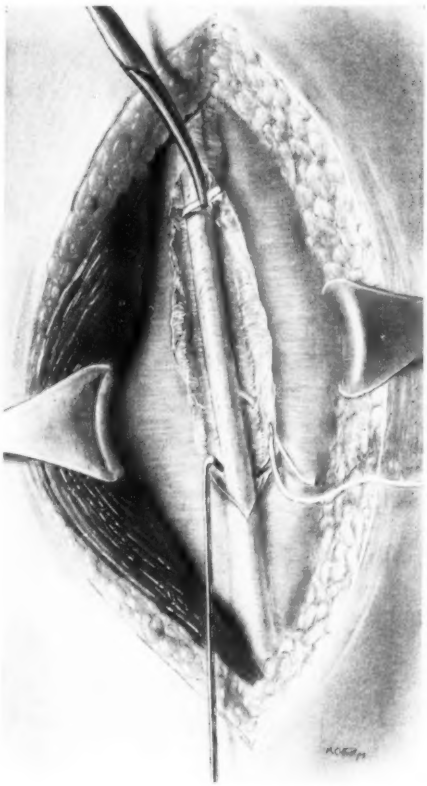

Fig. 1. Operative field, showing artery standing clear, with common sheath cut. Tapes being passed under the artery.

What, then, is the field for sympathectomy and what are the indications for its use in this field, if field it has? The answer to this question is that there is a great group of vascular disorders of the extremities which for the most part eventuate in gangrene, and it is here that one will find the real field for periarterial sympathectomy. And that the operation should be peculiarly adapted to certain of these cases is understandable when one recalls first that the sympathetic nerves normally found in the sheaths of large vessels control their contractile and expansile activities; and, second, that disorders of these activities are at the bottom of many of the circulatory conditions encountered.

As for operative indications, I would suggest that any case of circulatory trouble unex-

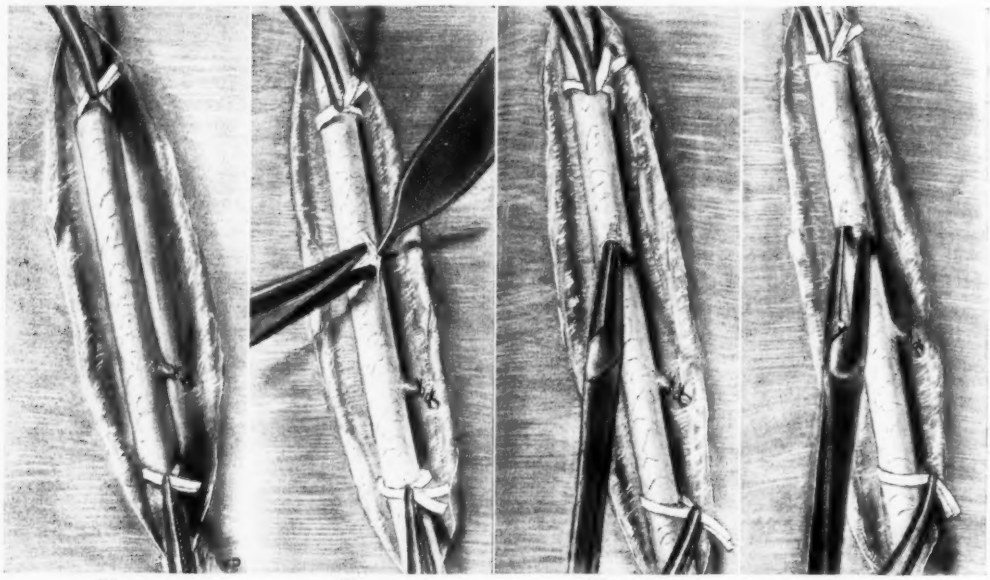

Fig. 2. Fig. 3. Fig. 4. Fig. 5.

Fig. 2. Artery dissected free from surrounding tissue and held up with tapes. Branches are tied and cut between the ligatures so that vessel may be lifted out of its bed and twisted and turned at will.

Fig. 3. Thumb forceps picking up a bit of the adventitia and scissors snipping it.

Fig. 4. Clamp placed in small opening of adventitia.

Fig. 5. Clamp in adventitia opened to receive scissors.

plained by some definite disease, which is manifested by pain, disability, intermittent spasticity of blood vessels, loss of pulsation in distal vessels, and ulceration of the digits or their gangrene, these signs and symptoms taken together or in groups, be considered sufficient warrant for the operation. This eliminates for the time being such affairs as diabetic disorders, the threatened gangrene of the aged, and certain forms of obliterating endarteritis dependent on some syphilitic infection. And I say "for the time being" advisedly, because further studies might even place them in the category of disturbances amenable to the procedure. The need for Leriche's operation, in fact the only need for it, in my opinion, is in these types of disorders and I predict that it will stand or fall as an entity of value on its usefulness in them.

Thus far only a beginning has been made, but the results obtained, while not brilliant, are such as to give rise to encouragement, together with the desire to make further trial, for the need is great. Successful cases have been reported by Callander, Muller, Halstead, Mitchell, and others. It is true that these same men chronicled failures also. In some instances the failures outnumbered the successes, but the successes were certainly striking and the cases in which they were obtained were hopeless as measured by any other constructive procedure. Some of the non-successes might very well be attributed to the fact that too much was expected in certain instances, and cases that should have had amputation in the first place were sympathectomized. Other failures, I feel sure, were due to incomplete removal of the adventitia. Indeed, it is on this latter account that I have been at such pains to picture the details of the operation and to emphasize the necessity of the most meticulous removal of this nerve-bearing arterial coat. This feature was brought home to me by one or two of my own partial successes, but more especially by personal talks I had on the general subject of periarterial sympathectomy this last winter with Leriche in Lyons, and his friend Hertz in

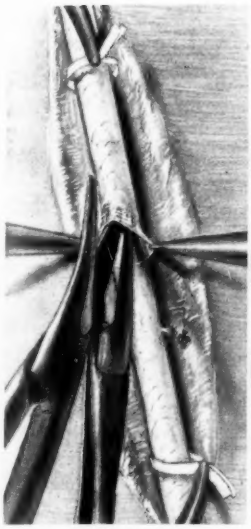

Fig. 6.

Fig. 7.

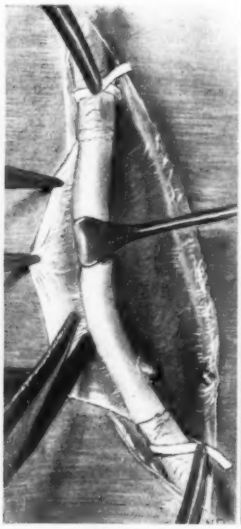

Fig. 8.

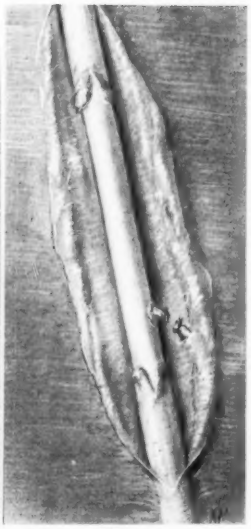

Fig. 9.

Fig. 6. Scissors cutting adventitia in direction of artery.
Fig. 7. Adventitia held free from the sides of the artery.
Fig. 8. Artery being rotated and adventitia dissected free with scissors. Clamps on one side of the adventitia have been removed.

Fig. 9. Artery lying in its bed, showing smooth, glistening coat of the muscularis. Adventitia cut at either end of the denuded area to avoid any constriction which might arise because the adventitia rolls up.

Paris. Hertz is even of the opinion that complete adventitial removal can be accomplished only by sharp dissection throughout the entire procedure. I cannot agree with him on this point, and I think the number of accidents that would occur if sharp dissection alone were used in this work would be so large as seriously to impair the usefulness of the operation. Complete adventitial removal, though, is essential to operative success. I accomplish this by going back for a second layer, as outlined, and even a third layer. But perhaps this feature of the operation will have to be left to each individual operator.

I have done nine of these operations on seven patients, the condition in each instance being that of the painful circulatory disorder which is the precursor of actual gangrene. This is a better way of designating the maladies than to give them a specific name such as, for instance, Raynaud's disease, thrombo-angiitis obliterans, or what not. For after all, the end-result is the same in all of them, and I am personally of the opinion that, if not always actually the same, they are certainly very closely related. Generalized arteriosclerosis, whether of the senile variety or associated with a disease like diabetes mellitus or syphilis is, of course, an entity and causes little or no confusion. Such other affairs as obliterating endarteritis, Raynaud's disease, and thrombo-angiitis, though, while of pathological individuality, perhaps, are ofttimes difficult to distinguish from one another clinically. In their early stages and in the mild cases, it does seem possible to differentiate them, especially the so-called Raynaud ones where irritability of the blood vessels as manifested by intermittent spasms of arterioles and venules with the consequent color changes of the toes and fingers is the outstanding feature. But in their later stages they present pictures so similar to each other that one is forced to the conclusion that, more than likely, they are nothing more than manifestations, somewhat different in character, of the same process. It must be remembered that while the suggestion has been advanced that certain types of blood vessel disorders, notably thrombo-angiitis obliterans, are in-

fectious processes, the infectious agent has never been discovered. My experience in blood vessel conditions, especially those associated with threatened and real gangrene other than the true sclerotic type, leads me to the belief that most of them arise primarily from an irritability of the terminal blood vessels but that the course may be different, probably by reason of some racial, climatic, toxic, or other unknown factor. It is with this conception in mind that I laid down the indications mentioned above for this operation of periarterial sympathectomy. Of the nine cases that I have done, four were successful in that their pain was relieved, their disability was removed, and function restored. When one considers that all nine of them had nothing to look forward to but eventual amputation this is a respectable percentage of relief. In one case the result was so startling that it deserves mention.

The patient was a stout, plethoric man of 60, a Russian by birth, who had been living in Texas for many years. He had lost his left leg 5 years ago because of pain and gradually increasing gangrene, and when I saw him he was in imminent danger of losing his right leg, which had become affected 5 months previously and had progressed, according to his story, exactly as had the leg that had been lost. The foot and lower leg were œdematous, his pain was continuous and so excruciating that sleep was impossible, and there was a dirty-looking ulcer on the big toe and another between the fourth and fifth toes. There was a femoral pulsation but no pulsation was to be felt in any of the arteries below. He had been in bed for 2 months under competent care, during which time every conservative measure for relief had been employed. The case conformed rather more to my conception of thrombo-angiitis than anything else, with Raynaud's disease the second choice.

A periarterial sympathectomy was done in May, 1924, with such amazing results as to warrant a real optimism in this work. The man's pain disappeared immediately after operation, his œdema subsided, the ulcers healed promptly, his popliteal pulse returned, he was able to sleep again and has since resumed his former occupation.

If such a result can be obtained in a limb which is on the verge of gangrene, it stands to reason that better results should be obtained in earlier cases.

It will thus be seen that the so-called periarterial sympathectomy of Leriche is a procedure that may be of great usefulness in the prevention and relief of circulatory disorders of the extremities that are wont to eventuate in gangrene. Quite some years ago the procedure was unconsciously in use as a step in those operations that had to do with any blood vessel suture, and certain of the beneficial results that came to pass following these operations, notably the so-called reversal of the circulation, in the light of our present knowledge must have been due to this operation. The operation consists essentially in the elimination of sympathetic nerve control over certain blood vessels as a result of which they are permitted to dilate and carry apparently a greater quantity of blood than they had been carrying.

Exact indications for its use remain somewhat problematical, but certain states characterized by a spastic condition of the blood vessels offer its greatest field. Nothing is to be hoped for in arteries completely thrombosed and at the present time the arteriosclerotic disorders, diabetic, syphilitic, do not seem to be amenable to relief in this manner, though it never pays to be too positive in such matters. Certain early cases may be helped.

The operation itself, while not simple or devoid of danger, is not too difficult and any surgeon of experience should be able to do it satisfactorily. The chief point of importance is to secure absolute removal of the adventitial coat of the artery, since the sympathetic nerve fibers are for the most part in this coat, and the purpose of the operation is their removal.

REPORT OF CASES

CASE 1. Mr. J. S., age 42, American. Had lost one leg as a result of obliterating endarteritis, syphilitic, some years previously and was in imminent danger of losing the other. There was no pulsation below the external iliac artery. Ulcers were present on the foot. Pain was exquisite. Periarterial sympathectomy done January, 1923, at the Union Protestant Infirmary. Operation was followed by slight relief of pain but the ulcers failed to heal and the condition of the leg was not improved. The artery was found completely thrombosed. A recent communication from the patient says: "The leg is getting along pretty well but the sores are not entirely healed." Nothing is said about pain, so conclusion must be drawn that this has been pretty much relieved. Just how much good, if any, the sympathectomy did in this case is problematical. I am inclined to think it had no effect whatsoever but

that the collateral circulation developed previous to the operation and since has been adequate to prevent actual gangrene of the tissues. This case is therefore put down as doubtful. It would be unfair to call it either a success or a failure.

CASE 2. Mr. D. A., age 31, Russian. Patient had pain in the right ankle and foot of 7 years' duration. It gradually got worse and an ulcer developed on the inner side of the leg above the ankle. It never healed. Femoral pulsation was felt but nothing below. Finally an ulcer developed on the big toe which became swollen and intensely painful. Diagnosis: Thrombo-angiitis obliterans. Periarterial sympathectomy was done January, 1923, at Hebrew Hospital, was followed by immediate healing of ulcer on lower leg but the toe got worse, the ulcer became larger, and the whole foot became threatened with gangrene. Amputation was done above the knee. Failure.

Note. This patient has a similar condition in the other leg and was advised to have sympathectomy done 3 months ago, but refused. It is possible that if it had been done earlier in first instance the result would have been better. It is interesting to note that the ulcer on the lower leg healed following sympathectomy.

CASES 3 and 4. Mr. B. C., age 43, Russian. Patient had intermittent pain and color changes in toes of right foot for over 1 year. Finally there was gangrene of middle toe. Arterial circulation was normal. Periarterial sympathectomy gave complete relief from pain and the gangrened toe gradually sloughed off. Diagnosis was Raynaud's Disease.

Some months later same trouble occurred in the left leg and followed the same course. Periarterial sympathectomy again gave good results, although it took months for the gangrenous toe on this foot to come away. Patient is able to be about again and has but slight pain and then only at times. First operation was done at Hebrew Hospital in March, 1923, second in February, 1924. Both successes.

CASE 5. Mr. I. H., age 33, Russian extraction. Patient had pain and cramps in calf of left leg. He is able to walk only a few blocks because foot becomes numb. A small ulcer has developed near the nail. The foot is rather cool but there are no intermittent color changes. Femoral and popliteal pulses are felt and there is a suggestion of pulsation in the dorsalis pedis artery, but nothing more. Conservative measures failed to give relief. Periarterial sympathectomy done January, 1924, gave some relief of discomfort while the ulcer healed entirely. Patient is able to get around satisfactorily but still complains of some pain. Diagnosis was thrombo-angiitis obliterans. Probabilities are that this man is much better than he admits. He served in France with the A. E. F. and has been at great pains to get compensation. Thus far he has received none. Improved.

CASES 6 and 7. Mr. M. K., age 47, Russian. For 3 years patient had had pain in right leg and right big toe. Walking gradually became impossible. Foot was red when in dependent position and blanched when held up. The muscles were atrophied. A femoral pulse was felt, nothing below. Diagnosis was thrombo-angiitis obliterans. Periarterial sympathectomy was done in March, 1923. There was but slight improvement. Amputation followed. Patient's left leg was similarly involved but did not become so painful until some months after first operation. Periarterial sympathectomy was done in April, 1924. Two days after operation patient developed a sudden hemiplegia and died. Both failures.

CASE 8. Mr. A. C., age 54, Russian. Patient had pain in right foot and big toe for 6 months, becoming progressively worse. The foot is quite red and rather cooler than left. An ulcer is present at distal edge of big toe-nail and extends under the nail. Femoral pulsation is to be felt, also at times popliteal. Dorsalis pedis and posterior tibial pulses are not felt. Diagnosis: Thrombo-angiitis obliterans, though Raynaud's disease must be considered. Periarterial sympathectomy was done at Hebrew Hospital in May, 1924, the big toe-nail being first cut back and later removed. Pain disappeared, the ulcer healed, and the patient was able to return to work. Arterial pulsation in August, 1924, same as above but patient quite well. Successful.

CASE 9. Mr. L. B., age 60, Russian. Patient had lost left leg 5 years ago from pain and gangrene. Similar trouble started in right leg, which gradually became painful and œdematous. Ulcers developed on the big toe and between the third and fourth toes. Pulsation was felt in femoral artery but none below. Diagnosis was thrombo-angiitis obliterans. Conservative measures gave no relief. Periarterial sympathectomy was done at Hebrew Hospital in May, 1924, gave complete relief, the œdema subsided, the ulcers healed, and the patient resumed former work. Successful.

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SUBASTRAGALOID ARTHRODESIS

A Study of End-Results[1]

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In order to study the end-results of operations for subastragaloid arthrodesis performed at the New York Orthopædic Dispensary and Hospital, an effort was made in 1922 to examine all the patients operated upon from 1914 to 1921 inclusive. The total number was 223 and of these 155 returned for examination. The study was made from these patients, and the 68 who failed to return were not included because the data in regard to the end-results were incomplete. The patients examined represented operations upon 198 feet. The interval between operation and the last examination varied from 6 months to 7½ years. The operations were performed by 13 different surgeons.

The operation is the one now used exclusively at this clinic for stabilizing the feet and is utilized in any condition where there is an imbalance leading to instability or deformity.[2] It is based on the principle that the astragalus is the most stable bone in the foot, and that practically all lateral motion or deformity occurs in the subastragaloid and mediotarsal joints. Motion is eliminated in these joints by fixing the os calcis and scaphoid to the astragalus and the cuboid to the os calcis. The procedure was used in this clinic soon after it was described by G. G. Davis of Philadelphia, but his technique was modified by making adequate incisions to obtain a good exposure of the joints and by removing cartilage and bone with a chisel instead of a curette.

Two incisions usually are used, one over the inner side of the foot commencing just below and in front of the medial malleolus and extending downward and forward across the astragaloscaphoid joint and the other reaching forward from the tip of the lateral malleolus across the calcaneocuboid joint. The complete exposure of the joints involved is best made before any cartilage is removed or any fitting together of the bones is attempted. Through the medial incision, exposure is made not only of the head and neck of the astragalus and of the scaphoid, but also of the joint at the sustentaculum tali. In approaching the joints on the outer side of the foot, it is necessary to split and dissect aside the extensor digitorum brevis. This exposes the calcaneocuboid joint and the promontory on the anterior aspect of the os calcis. Just posterior to the promontory is the subastragaloid fossa, so called by Hoke, which is filled with fat and the thick strong interosseous ligaments. At the back of the fossa are the anterior lips of the facets composing the large posterior part of the subastragaloid joint. It is necessary to remove the ligament, but care should be exercised to leave enough fat to prevent a dead space. After the exposure has been made, the cartilage is removed and the bony surfaces fitted. The head and neck of the astragalus are removed by a transverse cut sloping backward. The portion of the head and neck excised depends partly upon the degree to which it is desired to displace the foot posteriorly. The articular cartilage and the upper portion of the bone of the scaphoid then are removed in such a way that the cut surface faces backward and upward. This makes possible the sliding back of the scaphoid beneath the astragalus. The articular cartilage is also removed from the joint at the sustentaculum through this medial incision.[3] Through the outer side the cartilage is removed from between the os calcis and the cuboid, but unless the forefoot is adducted it is unnecessary to remove any bone. The subastragaloid joint is now dealt with by leveling off the entire superior surface of the os calcis on one plane. This necessitates cutting off the top of the

[2] We feel that while the operation is capable of yielding very satisfactory results in practically all cases, it is one of the most difficult to perform and demands much skill and experience from the surgeon if it is to be successful.

[3] In certain types of varus deformity it may be found easier to do the entire operation through the incision on the outer side of the foot.

[1] From the Clinic of New York Orthopædic Dispensary and Hospital.

Fig. 1. Roentgenogram of foot before operation. The lines of incisions through the bones and the portions removed are indicated. *1*, Calcaneo-astragalar joint, *2*, astragalo-scaphoid joint, *3*, calcaneo-cuboid joint. The bone is removed from *2* and *3* and the relationship between the rear and forefoot is adjusted before *1* is dealt with.

Fig. 2. Roentgenogram of the same foot after subastragaloid arthrodesis.

anterior promontory and of removing more than just the cartilage from the joint. This is illustrated in the accompanying cut. The cartilage and sufficient bone are removed from the inferior surface of the astragalus. By fashioning the surfaces of the os calcis and astragalus, either a varus, valgus or calcaneus position of the os calcis can be corrected; that is, the foot can be placed in a neutral position. In setting the foot back, it sometimes is necessary to go as far forward as the bases of the cuneiforms and when this is done the cartilage must be removed from their posterior surfaces. The bone should be removed in such a way that good contact is had with the foot in correct position without the use of force.

It is of prime importance to set the foot backward beneath the astragalus. This is true especially in calcaneus deformities but applies to varus feet as well. If this is not done the weight-bearing line will come through the posterior part of the foot and the strain will not be well distributed on the longitudinal arch. This leads, among other things, to a lateral strain on the foot which is liable to cause a stretching of the lateral ligaments and consequent instability. It has been found that even though the lateral ligaments are somewhat relaxed to begin with, if the foot is displaced backward sufficiently it will be stable and functionally good, provided, of course, there is not excessive rotation of the tibia. In the varus cases the os calcis is apt to be rotated forward and for this reason should be set back. It can be demonstrated by X-rays of calcaneus feet that the os calcis actually is deformed—the bone itself pointing downward rather than being simply rotated because of dorsiflexion of the foot. It is necessary to overcome this by removing a wedge, with the base posterior, from the subastragaloid joint. This enables the heel to be brought upward as well as backward. To get the os calcis far enough back, the lateral ligaments must be detached subperiosteally from it.

Fig. 3. Roentgenogram of foot before operation. There is a cavus deformity.

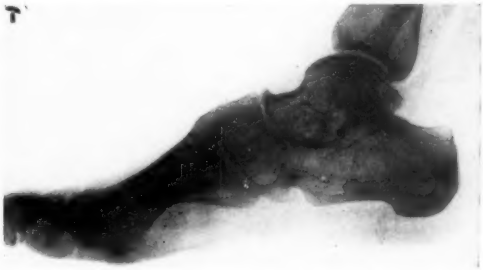

Fig. 4. Roentgenogram of foot after subastragaloid arthrodesis. The cavus has been corrected.

Fig. 5. Roentgenogram of foot before operation.

Fig. 6. Roentgenogram of same foot after operation. Note the extent to which the foot has been displaced posteriorly beneath the astragalus.

The wounds are closed in three layers, the skin with silk, and a plaster cast is applied from the toes to mid-thigh. It is essential to hold the foot in the correct position while the plaster is setting, but in order to make sure that this is done and to inspect the wound and remove the sutures, the plaster is changed at the end of 2 weeks. If it then is desired to make any change in the position of the foot, it can be done under nitrous oxide anæsthesia. The patient is discharged from the hospital at the end of 2 weeks with instructions to return to the dispensary at the end of 4 weeks for observation or a second change of plaster. A heavy cast is now applied and walking is started. The foot is kept immobilized in plaster for 12 weeks after operation. An ordinary shoe is then worn and massage is started. More recently the younger patients have been made to wear an ankle brace for a period long enough to insure maintenance of the correct position.

The cause of deformity in the feet examined was anterior poliomyelitis in 189, congenital club-foot and other congenital deformities in 7, trauma in 1, and splint malposition in 1. Although most of the cases were due to poliomyelitis, the operation has a wide field of applicability and is the most frequently used major procedure in this clinic. It is indicated, in addition, in deformities caused by spastic paralysis, fracture and malposition in the tarsus, tuberculosis of the subastragaloid joint in adults and in certain rigid pronated feet.

In this series 7 patients were from 8 to 10 years of age; 101 from 10 to 15; 39 from 15 to 20; 13 from 20 to 30, and 3 from 30 to 35. Formerly it was considered that, except under very unusual circumstances, the operation should not be done under 11 or 12 years of age, though Davis reported success in much younger cases. It has been found, however, since Hoke reported that he operated on feet in cases 4 or 5 years of age, that good bony contact can be obtained much younger and there is no longer any hesitation about operating on children of 6 or 7, or even younger if the deformity cannot be controlled otherwise. In these cases, particularly the ones with an original valgus deformity, support in the form of an ankle brace, and arch is used for 1 year. It is believed that in order to obtain a firm and lasting arthrodesis, contact must be had between surfaces of bone. However, in certain instances, particularly in cases of club-feet, in children 3 or 4 years of age, that have not been corrected, it has been the practice recently to correct the deformity through the subastragaloid joint, without expectation of getting bony union, and then to maintain the position in plaster for many months until the structures become adapted to the new position.

The type of deformity in this series was varus or equinovarus in 86 feet, valgus or equinovalgus in 83, and calcaneus—mainly valgus, a few varus, and all with varying degrees of cavus—in 26; 5 feet had flail-joints with the tendency to varus. It is interesting to find that the results in the calcaneus feet were better than in any other type. The degree of relaxation which was due in part to the type of the deformity as well as to the extent of paralysis, was extreme in 153 and moderate in 13. However, it should be noted that the astragalus is usually solidly placed

in its mortice between the malleoli even in the most severely relaxed feet. The ability of the patients to walk before operation was poor in 173 cases and fair in 8. Three were unable to walk without braces and 1 was unable to walk at all. This disability was largely concerned with paralysis above the leg and foot, though stabilization has much to do with controlling the entire extremity.

Included in the various methods of treatment before the subastragaloid operation in these patients were certain operative procedures which were not successful in balancing the foot. There were 6 tendon transplants, 6 tendon fixations, 7 instances of division of ligaments, including in 2 the plantar structures; 15 cases of lengthening of the tendo Achillis; 1 shortening of the tendo Achillis, 1 silk ligament insert, 1 attempted subastragaloid arthrodesis, 2 astragaloscaphoid arthrodeses, 1 case in which the subastragaloid joint was curetted together with a lengthening of the posterior tibial tendon, and 1 tarsal wedge resection.

As supplementary procedures the following operations were performed at the same time as the subastragaloid arthrodesis: lengthening of the tendo Achillis, 3 cases; transplantation of the peroneus longus into the tendo Achillis, 3 cases; transference of the tibialis anticus into the outer side of the foot, 3 cases; division or lengthening of the tibialis posticus and release of the internal lateral ligaments of the foot (in club-feet), 2 cases; fixation of half of the tendo Achillis in the tibia, one case; release of the plantar structures and transplant of the extensor hallucis longus into the scaphoid, 1 case.

Following the subastragaloid arthrodesis, 11 cases had the tendo Achillis lengthened; 1 had an arthrodesis of the phalangeal joint of the great toe, and 1 a transplant of the digitorum longus tendons into 1 of the cuneiform bones. Because the subastragaloid arthrodesis had been done inefficiently it was necessary to follow it with a resection of the tarsus in 1 case and arthrodesis of the astragaloscaphoid joint in another.

The upper extremities were involved in 15 cases, the abdominal muscles in 8, the back muscles in 29, the muscles about the hip in 116 and the quadriceps in 115. One or more of the muscles acting upon the foot were affected in each case of the poliomyelitis group.

In all but a very few cases the operation made it possible for the patient to discard braces provided they were worn because of weakness of the foot alone. In some cases of weak or paralyzed quadriceps muscle, where there was sufficient equinus to force the knee into hyperextension, the operation, by stabilizing the foot laterally, made it possible to discard the brace.

Although it now is the established routine to change the first plaster cast at the end of 2 weeks, to have the patient walk in plaster at the end of 6 weeks and to remove the cast in 12 weeks, this varied somewhat in these cases, and still varies to some extent. The plaster was removed before the eighth week in 8; at the eighth week in 50, and between the eighth and twelfth weeks in 62. It was found that there was a larger percentage of poor results among those in whom the cast was removed before 8 weeks than in those removed later. This is explained by the softness of the bone and the tendency of deformity to recur.

The end-result was estimated by taking into account the position of the foot and the degree of correction of the deformity, the fusion between the bones, and the function in weight bearing and walking. The correction of the deformity was complete in 118 cases; fairly complete in 58 and poor in 21; overcorrected in 1. Many of those in whom the deformity was not completely corrected had a good functional result because of the improvement of the stability of the foot. Weight bearing was excellent or good in 122 cases, fairly good in 3, fair in 52 and poor in 20. Four still were unable to walk without braces because of extensive paralysis of the extremity.

The union was bony in 157; firm fibrous, 10; fibrous with some instability, 30; non-union, 1. The percentage of cases in which union was not solid was therefore 15.6. These were cases in which care was not taken to obtain good contact between bone surfaces in each joint. In some the joints were simply curetted and in others sufficient cartilage was not removed. If the conditions are fulfilled properly good firm union is certain to occur.

The astragalus was stable after operation in 125 cases; slightly or moderately relaxed in 63; severely relaxed in 10. In a few of these the relaxation of this bone was definitely present before operation, but in others it occurred after operation either from the fact that the foot was in poor position, thereby causing a severe strain on the lateral ligaments or because the ligaments were divided during the operation. Both these factors are unnecessary and should be avoided. Other things being equal, the excellence of the end-result corresponded with the degree of stability of the astragalus, but it was found that even with relaxed lateral ligaments the result was good if the foot had been set back properly and was in the neutral position laterally so that the weight thrust came near the center of the arch.

The results in cases operated upon at 10 years of age or earlier were excellent or good in 62.5 per cent, fair in 6.2 per cent, and poor in 31.2 per cent. While the percentage of excellent and good results here is the same as in the older cases, there are comparatively more poor results than fair. This is believed to be due, not to the age of the patient, but to the fact that the operations were improperly carried out and also to the fact that the feet were not supported for a sufficient time after operation. It is possible to obtain a good result in any foot the bones of which are sufficiently ossified to give contact with bony surfaces. This is possible in almost all cases at 7 years, and often earlier.

The calcaneus deformities, including calcaneovalgus and calcaneovarus as well as the simple calcaneus deformities yielded better results than the entire series or any special group. They were excellent or good in 92.3 per cent, being optimum in only 54 per cent; fair in 3.8 per cent and poor in 3.8 per cent. The results in the valgus feet were better than in the varus. The former were excellent and good in 66.2 per cent, being optimum in 40 per cent; fair in 26.5 and poor in 7.2 per cent. The results in the varus feet were excellent and good in 59.3 per cent, being optimum in only 28 per cent; fair in 27.9 and poor in 12.7.

There were superficial infections in 12 cases, or 6 per cent. In no case was the infection serious, nor did it interfere with union of the bones. In a few others there was a hæmatoma or necrosis of the skin margins which interfered with primary union but which was not caused primarily by an infection.

For the entire series of cases, and with all factors considered, the end-result was excellent or good in 66.1 per cent, being optimum in 37.3 per cent; fair in 23.7 per cent; poor in 9.6 per cent.

The failures, poor and fair results, are all due to imperfect operative technique, removal of plaster too soon after operation, or to rotation of the tibia. Some few which were placed in good position at the time of operation failed to remain so because the plaster was removed too soon for weight bearing without support, and others failed because sufficient cartilage was not removed to obtain good approximation of bone at the time of operation. The majority of poor results, however, were due to failure to obtain a perfect position of the foot either laterally or anteroposteriorly, or both. That is, the neutral position was not obtained for the maintenance of lateral balance, or the foot was not set back sufficiently to create good weight bearing across the longitudinal arch. However, in some cases in which the feet were well placed after removal of the plaster the outward torsion of the tibia was great enough subsequently to reproduce valgus deformity in spite of arthrodesis. This cannot be prevented in any way except by osteotomy of the tibia before or soon after the arthrodesis. This fact previously has been pointed out by Hoke.

We are convinced that the optimum result can be obtained in any foot in which the bones are sufficiently ossified provided that the following conditions are met: (1) securing good bone contact; (2) correcting the deformity of the foot; and (3) making sure that the foot is in proper relationship to the leg by performing if necessary an osteotomy of the tibia.

CONCLUSIONS

1. Subastragaloid arthrodesis is an operation of great usefulness and wide applicability for stabilization of the foot if correctly done, but it is one of the most difficult operations to perform and demands from the surgeon much

skill and experience as well as meticulous after-care.

2. It is of prime importance to displace the foot backward beneath the astragalus as well as to get it in a neutral lateral position.

3. The astragalus is stable in the majority of cases. In the few in which it is not, subastragaloid arthrodesis still can be done successfully provided the foot is well placed laterally and anteroposteriorly.

4. The operation is adapted to nearly every type of foot deformity. In this series the best results were in the calcaneus feet.

5. The operation may be performed as early as the sixth or seventh year.

6. The poor results were due in every case to failure to obtain good position of the foot at operation, to the removal of the plaster support too soon after operation, to the failure to obtain fusion, or to disregard the torsion of the tibia. These errors were the result of our ignorance as to the function and the mechanics of the foot.

7. The optimum result can be obtained in practically all cases provided the conditions are fulfilled.

PANCREATIC LITHIASIS

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A CAREFUL search of the literature, both English and foreign, brings to light only 22 cases in which pancreatic calculi have been removed at operation. This is in keeping with statements, made by various authorities, relative to the rarity of this condition. The object of this paper is to review the literature on the subject and report a case successfully operated on. In spite of the fact that it is not a common disease, pancreatic lithiasis is of more than academic interest. An article by Moses Barron in which he reported a case of pancreatic stone, stimulated Banting and led him to the development of insulin. Barron's case illustrated the fact, previously brought out by Opie, that obstruction of the pancreatic duct is accompanied by atrophy of the pancreas, but that the islands of Langerhans remain intact even when the acini disappear completely, and as a result glycosuria does not develop unless an interstitial pancreatitis is superimposed.

The condition was first reported by Graff in 1667. A few cases were reported up to the end of the nineteenth century. Oser in 1900 collected 70 cases from the literature and to these may be added 19 of the operative cases here reported and 10 cases reported by Kinnicutt, 1902; Kellock, 1902 (mentioned by Moynihan); Phillips, 1904; Muller, 1903; Atkinson and Hirsch, 1907; Opie, 2 cases, 1910; Pforringer, 1912; Bissell, 1913; Barron, 1920. With the one here reported this makes a total of 100 cases. Opie found 2 cases in 1500 autopsies which represents the average of the frequency reported by others. Probably more are seen than reported.

The cause of pancreatic stone is obscure. Stasis is probably an important element in their formation. Stasis is rarer in the pancreatic ducts than in the bile ducts because of the presence of the accessory pancreatic duct. Either both pancreatic ducts must be obstructed or one must be obliterated or absent. Obliteration of the duct is not uncommon whereas stone formation is rare, indicating that stagnation of the secretion alone does not explain the formation of stone. In repeated animal experiments which have been reported, ligation of the duct was not followed by stone formation. The composition of pancreatic calculi is interesting in that calcium carbonate is an important constituent. The fact that the normal pancreatic secretion contains no calcium carbonate would indicate that an altered secretion precedes stone formation. It seems reasonable to conclude that the secretion altered either by infection or pancreatitis will, in the presence of stasis, produce calculi. That the reflux of bile into the duct is not to be considered a common cause of pancreatitis has been shown by the

work of Mann and Giordano. In previously reported cases of pancreatic stone about 75 per cent have been in males. It is interesting to note that of the operative cases which I have collected only 5 were in males and 15 were in females. The average age in the series operated upon was 43 years.

Fine sand and very small stones are not so rarely noted in the pancreatic ducts. As a rule when stones are present they are multiple. Usually they are in the ducts, either in the main duct or its smaller radicles. In several instances the entire pancreas has been found filled with stones. The favorite site for their lodgment seems to be at the point where the main duct passes through the duodenum. Occasionally stones are found in cysts or abscesses. Gaillard reported a case in which calculi in the tail of the pancreas ulcerated through into the stomach, and Clayton reported an instance of pancreatic calculi ulcerating through into the peritoneal cavity. Marked hæmorrhage from the bowel due to ulceration into the duodenum of a pancreatic abscess caused by stones, was observed in the case of Nicholas and Molierre. The size of the calculi varies considerably, the largest reported being 2½ inches in diameter. In appearance they are white or grayish white, irregular, and not unlike salivary calculi. In Ruth's case they were facetted and worn smooth by the action of the aorta. Cholesterin is occasionally found in these stones and, when they pass into the ampulla, they may receive a coating of bile salts.

Occlusion of the pancreatic duct does not cause the development of retention cysts, although von Recklinghausen and Allen describe cases of cyst formation apparently due to impacted calculi. Lazarus showed that no retention cysts develop from ligation of the duct of Wirsung. This condition is probably analogous to that in the kidney, where sudden occlusion of the ureter produces only a slight retention, while gradually developing obstruction gives rise to a high grade hydronephrosis. Occlusion of the duct by stone gives rise to atrophy of the gland which is characterized by an interlobular type of pancreatitis which spares the islands of Langerhans until late in the process. In the cases operated upon which are tabulated the following associated lesions were noted: Abscess of the pancreas in 3; pancreatic cyst in 1; carcinoma of the pancreas in 1; gall stones in 3; diseased appendix in 1; enlarged spleen in 1; duodenal ulcer in 2. The condition of the pancreas was noted as enlarged in 3; atrophied in 1; interstitial pancreatitis in 1; gland tissue thinned and ducts dilated in 1; fat necrosis in 1.

Pain is the most important symptom of this condition and is variable in character. It is usually epigastric and may be dull and continued or intermittent, occurring in colics similar to those of gall stones. Radiation to the lumbar region, especially the left, is said to be characteristic of pancreatic stone and was present in four of the patients operated on. Glycosuria, when present, occurs only in advanced stages of the condition and is then due to the interlobular pancreatitis and not to the stone itself. Opie states that when diabetes is caused by a lesion of the pancreas the lesion always involves the islets and, conversely, whenever the organ is diseased but diabetes is absent, the islets remain relatively free from involvement. In the 70 cases collected by Oser 24 showed diabetes or transitory glycosuria, the latter symptom being considered an important one by various men. In the 21 cases operated upon glycosuria was noted in only 1 at the time of operation and in another it developed some years later, the patient dying of diabetes mellitus. Changes in the stools due to disturbance of the pancreatic function are occasionally noted but are not common. Fatty stools were present in only 3 of the cases operated upon. In several instances stones have been passed in the stools. Weight loss has not been emphasized as an important symptom, but it is worth noting that marked loss in weight was present in 9 of the 22 cases operated on. Jaundice is not uncommon. In the series operated upon it occurred six times. In two cases it was associated with gall stones, and in four cases no gall stones were present. It is important to point out the two cases in which there occurred painless jaundice with weight loss and strength loss, and no glycosuria, as this syndrome is usually associated with malignant disease involving the head of the pancreas and the

common bile duct. In two cases irregular pigmentation of the skin was observed.

As the symptoms would indicate, diagnosis is difficult if not impossible and was made only twice before operation. In the cases treated surgically positive functional disturbance of the pancreas was noted only rarely. Even when the abdomen is opened the location and consistency of the pancreas make palpation of uncertain value. Several cases in which mistakes in diagnosis were made are of interest. In Phillip's case the patient was operated on for gall stones and none was found. Jaundice persisted and sugar appeared in the urine, the patient dying in coma. At autopsy numerous stones were found in the duct of Wirsung. Pforringer's patient had pain in the right side originating in the lumbar region and showed an X-ray shadow which was somewhat nearer the vertebral column than is usual in kidney stone. Operation for renal calculus was done but none was found. The patient died of hæmorrhage and autopsy revealed a calculus in the main duct of the pancreas. Link operated for intermittent hydronephrosis on the left side and found the kidney involved in a surrounding inflammatory process. The tail of the pancreas was found filled with calculi. Murray operated on a patient for gall stones but found none and 6 weeks later, after the patient had a severe attack of pain, he removed a stone from the pancreatic duct. Mayo-Robson suggested the use of the X-ray in the diagnosis of this condition because of the large amount of calcium which is present in these stones. Its use is noted in three of the operated cases. In Hartig's case the X-ray was negative but stones were found at operation. In Lindsay's case the X-ray showed shadows outside the stomach. Postoperative X-ray in Lacoutre's and Charbonnel's case showed overlooked stones.

Two of the 22 operative cases died, so that the mortality rate, with the case here added, would be about 8.5 per cent. This series demonstrates that the action of the pancreatic juice on the tissues is not to be considered dangerous in pancreatic surgery. In the two cases which died, no evidence of fat necrosis was found nor was any other complication present which was due to the fact that pancreatic tissue had been worked on. In no case of removal of stones did a permanent fistula develop. There are three routes of approach to the body of the pancreas. It may be reached either by opening the gastrohepatic omentum, the great omentum, or the transverse mesocolon. The latter route gives access to the tail of the gland, and care should be exercised in this procedure not to injure the middle colic artery. In removal of stones which have lodged in the terminal portion of the duct of Wirsung, the duodenum is drawn to the left and incision made through the mesentery of the duodenum, as was illustrated by Sistrunk. Senn commented on the fact that limited injury of the duodenal mesentery such as is necessary in this operation is relatively safe and not followed by death of the bowel. Stones located in the termination of the duct or in the ampulla may be removed by incising the duodenum and passing a scoop directly into the ampulla as was done in Moynihan's case.

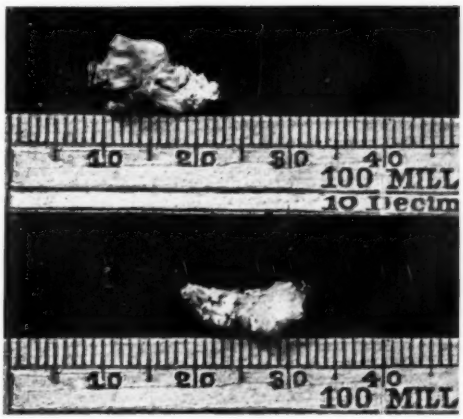

Fig. 1. Photograph of pancreatic calculus removed in author's case.

The following is a report of a case in which I successfully removed a pancreatic stone.

The patient, a man, age 42, was referred to me by Dr. De Nosaquo and was admitted to Milwaukee Hospital in August, 1920. The family and personal histories were irrelevant and except for the present trouble, the man had always been in good health. He worked at his trade which was that of a carpenter. For 7 years before admission to the hospital he had stomach trouble which was characterized by

CASES OPERATED UPON REPORTED IN LITERATURE

Reported by	Age, Sex	Pain	Other Symptoms	Jaundice	Gall Stones	Glycosuria	Pathology	Outcome
Caparelli, 1876						Sugar late in disease	Many stones in an abscess	Recovered. Death years later from diabetes.
Prewitt, 1898			Weight loss, tumor				One stone in abscess	Not stated.
Gould, 1898	M. 46	Absent	Loss of weight, strength and appetite. Clay colored stools	Marked	None	None	Pancreas and liver enlarged. Pancreas contained several stones in body and in duct of Wirsung. Stones were ca.-carb.	Died, 12th day. Peritoneum clear except for abscess in region of cæcum.
Dalziel, 1902				None	None		One stone in duct of Wirsung. Size of a pea	Recovery.
Moynihan 1902	F. 57	Epigastric of type of hepatic colic but less severe. Radiated to back	Wasting of flesh. General health loss. Pigmentation of skin in patches. Greasy, frothy stools. No chills or fever	None	None	None	Pancreas enlarged especially head. One stone in terminal portion of duct	Recovery.
Allen, 1903 (Clark-Burnam)	F. 30	Paroxysmal, epigastric radiating to left lumbar area	Lost 50 pounds in 1 year. Chills and fever. Clay colored stools	Early for one week. Not with later pain	None	None	Two cysts of pancreas containing two stones. Calcareous material throughout pancreas, which was atrophic. Autopsy report showed islands of Langerhans preserved	Died, 5th day. Autopsy showed no peritonitis.
Mayo-Robson, 1904	F. 57	Severe			None	None	One stone in duct of Santorini, two in duct of Wirsung, one in pancreas	Recovery.
Hollander, 1905	M. 48	None	Marked jaundice, emaciation. Enlarged liver and spleen. Epigastric tumor (late), clay colored, fatty stools	Marked	None	None	Pancreatic cyst containing fluid containing cholesterin and one ca.-carb. stone	Recovery.
Staehlin and Roeber, 1905	F. 39	Deep seated, boring pain in epigastrium. Intermittent attacks	Fatty stools	None	None	None	Four stones in head of pancreas	Recovery.
Ruth, 1907	F. 27	Upper abdominal colic	Long history. Never strong. Stools normal	None	None	None	Pancreas large. Many ca.-carb. stones in duct in body of pancreas. Some were polished by movement of aorta	Recovery.
Link, 1911	F. 22	Paroxysmal, left kidney region, radiating down ureter	Emaciation, anæmia, intermittent hydronephrosis suspected and operation for this performed. Kidney normal. Stools normal	None	None	None	Multiple calculi with marked interstitial pancreatitis	Recovery.
Friedlander, 1911	F. 54	In attacks. Upper right abdomen	Fever and vomiting with attacks	Following attacks	Present	None	Cholesterin stones in gall bladder, common-duct, pancreatic duct and head of pancreas. Chronic cholecystitis	Recovery.
Murray, 1911	F. 40	Severe, epigastric, in attacks	Long history. Operation for gall stones. None found. Six weeks later operation for pancreatic stone	With later attacks	None	None	Gall stones. One stone in pancreatic duct	Recovery.
Lacoutre and Charbonnel, 1914	F. 32	Violent attacks, upper right abdomen radiating to back	Vomiting	None	None	None	Two ca.-carb. stones. One in head of pancreas, and one in wall of gall bladder	Recovery. Later X-ray showed overlooked stones.

CASES OPERATED UPON REPORTED IN LITERATURE—Continued

Reported by	Age, sex	Pain	Other Symptoms	Jaundice	Gall Stones	Glycosuria	Pathology	Outcome
Dowd, 1915	F. 32	Severe epigastric, referred to pancreas	History over several years. Passed mulberry calculi in stools	None	None	None	Fat necrosis. Abscess in head of pancreas. Thirty or more stones in the abscess	Recovery.
Hartig, 1915	M. 34	Upper abdominal radiating to shoulders	X-ray negative, stools normal	None	None	None	Two calculi in a carcinoma of head of pancreas	Recovery for 5 months. Death due to carcinoma
Navarro, 1921	F. ?	Pain similar to that of gall stones	Dull ache over pancreas	Recurring	Present	None	Three calculi in pancreas. Cholecystitis with stones	Recovery.
Lindsay, 1922	M. 29	Violent epigastric radiating to back and to left	15 year history. X-ray showed shadows outside stomach. Stools normal. Irregular pigmentation on face, neck, and chest. Slight wasting for 2 years	None	None	None	Six large and many small stones of ca.-carb. in pancreas. The gland tissue was thinned and the ducts dilated and thickened. Cultures sterile	Recovery.
Sistrunk, 1921	F. 48	Epigastric, cramp-like	Diarrhœa. Loss of weight and strength	Marked			Had a duodenal ulcer. Gastro-enterostomy made. Spleen large. One stone about 1½ in. above ampulla in pocket of pancreas	Recovery.
Sistrunk	M. 33	Colicky, several years	Operated upon 1 year before for gall stones. Pancreas found to contain stones then, but these were not removed until later operation		Present	Present	Many stones in duct of Wirsung and pancreas. Some in duct of Santorini not removed. Appendix diseased	Increased sugar tolerance. Recovery.
Sistrunk	F. 68	Epigastric, radiating to left	15 pound weight loss				Many stones in head of pancreas, apparently in main duct	Recovery.
Sistrunk	F. 62		Duodenal ulcer history 15 years				Ulcer found. Gastro-enterostomy. One stone in pancreatic duct near ampulla	Recovery.

belching, pyrosis, nausea and occasional vomiting. He was bothered considerably by burning in the pit of the stomach. He had pain in the epigastrium which, however, was never severe enough to disable him. The pain never required morphine. There seemed to be no relation between the pain and the taking of food except that meats aggravated it somewhat. The pain radiated to the right scapular region. At times after meals he had a crowding upward of gas. He thought that his eyes were slightly yellow at times. He thought that his stools had always been normal. He had been chronically constipated. He never vomited blood. Four years ago he was operated on at another hospital. He does not know what was done. He was not benefited in any way by the operation. Since that time he had dieted and taken soda over long periods without relief. The general physical examination was negative, the patient being a well developed and well nourished man. Examination of the abdomen showed a straight scar four inches long in the upper right quadrant of the abdomen. The abdomen was readily palpable. There were no masses present. The right kidney could be palpated. There was tenderness on pressure between the umbilicus and the sternum. There was marked tenderness over the gall bladder and no tenderness over the region of the appendix. Repeated examinations of the urine were negative and no sugar was found at any time. Wassermann test was negative. X-ray examination of the stomach was negative. The pre-operative diagnosis was chronic cholecystitis without stone. Operation was thought justified by the long history and failure of medical relief and the patient's desire to have something done. He was operated on under ether anæsthesia on August 6. Judd's gall-bladder incision was made. Firm adhesions of the transverse colon to the anterior abdominal wall were encountered. These were divided. The stomach was also adherent to the abdominal wall and was freed. The gall bladder was found normal, contained no stones, and was not disturbed. The common duct was negative to palpation. The first portion of the duodenum was normal. A mass about 2 centimeters long by 1 centimeter in diameter was felt back of the lesser curvature of the stomach and on opening through the gastrohepatic omentum, it was found that this mass was in the body of the pancreas. A small incision was made into the substance of the gland and a stone, irregular in outline, 1.6 centimeters by 0.7 centimeter by

0.5 centimeter was revealed. This was removed. It lay about 0.5 centimeter below the surface of the gland. The incision in the pancreas was closed with interrupted sutures of plain catgut. Further exploration of the pancreas was negative it being normal in size and consistency. Exploration of the stomach was negative. The rent in the gastrohepatic omentum was closed no drainage being employed. The postoperative course was uneventful with the exception of a bronchitis which was somewhat troublesome for the first week. The highest temperature was 101.2 degrees on the second day. The temperature did not go above normal after the fifth day. The wound healed by primary intent. He left the hospital on the fourteenth day. Repeated reports on this patient since that time have been to the effect that he has been entirely relieved of symptoms which he had prior to operation. The chemical analysis of the stone showed magnesium and sodium phosphates to be present in large amounts and calcium to be present in small amount. In addition there were small amounts of ether- and alcohol-soluble substance and of cholesterol-like material.

The tabulation of the cases operated upon does not include the case of Weir which is listed by some authors, as in his paper describing the operation he states that no stone was found.

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THE ORAL ADMINISTRATION OF SODIUM TETRAIODOPHENOLPHTHALEIN FOR CHOLECYSTOGRAPHY[1]

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THE work of Graham, Cole, and Copher (1, 2, 3), upon the intravenous injection of sodium tetrabromphenolphthalein for the purpose of cholecystography has aroused widespread interest in medical circles, and has opened up a field of great possibilities. Because of the somewhat complicated technique of administration and the tendency to reaction following it, however, clinicians and roentgenologists have been slow to adopt the method, and have been hoping for a simpler and less troublesome means whereby shadows of the gall bladder might be obtained. For these reasons we attempted the oral administration of the drug, sodium tetraiodophenolphthalein. Graham and his collaborators have been trying new methods of giving sodium tetrabromphenolphthalein by mouth and by rectum, but their results have not been published (4). In our hands sodium tetraiodophenolphthalein by intravenous injection gives shadows superior to those produced by the bromine compound (5). This, with its comparatively slight toxicity in the amounts necessary to obtain shadows, gave reason to suppose that the drug would also be superior for oral administration.

Experimental work on giving the drug by mouth was stimulated by an interesting observation made by M. C. Sosman, roentgenologist at this hospital. In doing a routine gastro-intestinal series following cholecystography by intravenous injection, Sosman noticed that the gall-bladder shadow, which was absent at 24 hours, had reappeared at the end of 72 hours. This indicated that after the salt had been excreted by the biliary system some of it was absorbed from the alimentary canal and again excreted in the bile, thus allowing a second cholecystogram 72 hours after the first. In dogs, 0.4 grams of the salt per kilogram of body weight, given by stomach tube in 1 per cent solution, produced good gall-bladder shadows in from 12 to 24 hours.

Preliminary trials. Since the dogs suffered no ill effects except vomiting in some cases, we decided to perform the test upon a human subject. Consequently a dose of 0.1 gram per kilogram, about twice the dose for intravenous injection, was taken with the stomach empty in a 5 per cent solution followed by a pint of water. There was a slight iodoform taste with an astringent quality which persisted until acid fruit juice was taken. Aside from a temporary sense of nausea experienced shortly afterward and a loose bowel movement 4 hours later, the taking of the drug caused no inconvenience. The fæces gave a strong test for sodium tetraiodophenolphthalein. The gall-bladder shadow began to appear after 6 hours and was very distinct in 12 hours (Fig. 1).

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The ease with which shadows were produced by the oral administration of sodium tetraiodophenolphthalein and the temporary character of the nausea in most cases made us believe that if a method could be found whereby the substance would pass through the stomach without coming in contact with the mucous membrane, nausea would be avoided, and the test would become practical. Several methods were tried, until finally pills of the salt, double coated with salol in syrup of Tolu, answered the requirement. One subject took a dose in this form of about 0.045 gram per kilogram of body weight, the average intra-

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0.5 centimeter was revealed. This was removed. It lay about 0.5 centimeter below the surface of the gland. The incision in the pancreas was closed with interrupted sutures of plain catgut. Further exploration of the pancreas was negative it being normal in size and consistency. Exploration of the stomach was negative. The rent in the gastrohepatic omentum was closed no drainage being employed. The postoperative course was uneventful with the exception of a bronchitis which was somewhat troublesome for the first week. The highest temperature was 101.2 degrees on the second day. The temperature did not go above normal after the fifth day. The wound healed by primary intent. He left the hospital on the fourteenth day. Repeated reports on this patient since that time have been to the effect that he has been entirely relieved of symptoms which he had prior to operation. The chemical analysis of the stone showed magnesium and sodium phosphates to be present in large amounts and calcium to be present in small amount. In addition there were small amounts of ether- and alcohol-soluble substance and of cholesterol-like material.

The tabulation of the cases operated upon does not include the case of Weir which is listed by some authors, as in his paper describing the operation he states that no stone was found.

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THE ORAL ADMINISTRATION OF SODIUM TETRAIODOPHENOLPHTHALEIN FOR CHOLECYSTOGRAPHY[1]

By LESTER R. WHITAKER, M.D., Boston, Massachusetts, GIBBS MILLIKEN, M.D., Galveston, Texas, and EDWARD C. VOGT, M.D., Boston, Massachusetts

THE work of Graham, Cole, and Copher (1, 2, 3), upon the intravenous injection of sodium tetrabromphenolphthalein for the purpose of cholecystography has aroused widespread interest in medical circles, and has opened up a field of great possibilities. Because of the somewhat complicated technique of administration and the tendency to reaction following it, however, clinicians and roentgenologists have been slow to adopt the method, and have been hoping for a simpler and less troublesome means whereby shadows of the gall bladder might be obtained. For these reasons we attempted the oral administration of the drug, sodium tetraiodophenolphthalein. Graham and his collaborators have been trying new methods of giving sodium tetrabromphenolphthalein by mouth and by rectum, but their results have not been published (4). In our hands sodium tetraiodophenolphthalein by intravenous injection gives shadows superior to those produced by the bromine compound (5). This, with its comparatively slight toxicity in the amounts necessary to obtain shadows, gave reason to suppose that the drug would also be superior for oral administration.

Experimental work on giving the drug by mouth was stimulated by an interesting observation made by M. C. Sosman, roentgenologist at this hospital. In doing a routine gastro-intestinal series following cholecystography by intravenous injection, Sosman noticed that the gall-bladder shadow, which was absent at 24 hours, had reappeared at the end of 72 hours. This indicated that after the salt had been excreted by the biliary system some of it was absorbed from the alimentary canal and again excreted in the bile, thus allowing a second cholecystogram 72 hours after the first. In dogs, 0.4 grams of the salt per kilogram of body weight, given by stomach tube in 1 per cent solution, produced good gall-bladder shadows in from 12 to 24 hours.

Preliminary trials. Since the dogs suffered no ill effects except vomiting in some cases, we decided to perform the test upon a human subject. Consequently a dose of 0.1 gram per kilogram, about twice the dose for intravenous injection, was taken with the stomach empty in a 5 per cent solution followed by a pint of water. There was a slight iodoform taste with an astringent quality which persisted until acid fruit juice was taken. Aside from a temporary sense of nausea experienced shortly afterward and a loose bowel movement 4 hours later, the taking of the drug caused no inconvenience. The fæces gave a strong test for sodium tetraiodophenolphthalein. The gall-bladder shadow began to appear after 6 hours and was very distinct in 12 hours (Fig. 1).

Seven house officers at this hospital then kindly volunteered to submit to the test. The drug was given in doses of 0.1 gram per kilogram of body weight in 5 per cent solution with malted milk. The taste and astringency were not disguised by this method; one of the subjects vomited after 10 minutes; another after an hour and a half. In the other 5 there was a temporary nausea. One had a moderate diarrhœa. Six out of the 7 showed definite gall-bladder shadows, even though in 1 case the salt was retained only 10 minutes.

The ease with which shadows were produced by the oral administration of sodium tetraiodophenolphthalein and the temporary character of the nausea in most cases made us believe that if a method could be found whereby the substance would pass through the stomach without coming in contact with the mucous membrane, nausea would be avoided, and the test would become practical. Several methods were tried, until finally pills of the salt, double coated with salol in syrup of Tolu, answered the requirement. One subject took a dose in this form of about 0.045 gram per kilogram of body weight, the average intra-

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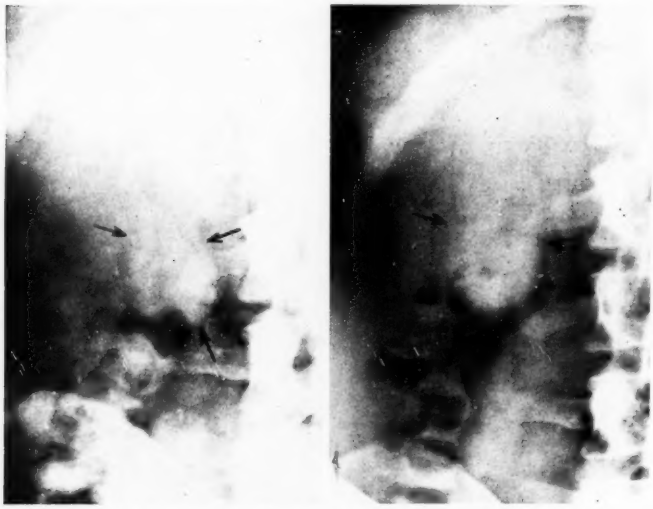

Fig. 1 (left). Twelve-hour film after oral administration of 0.1 gram per kilogram of sodium tetraiodophenolphthalein in 5 per cent solution. Same subject as in Figures 2, 3, and 4.

Fig. 2. Twelve-hour film after intravenous injection of 0.08 gram per kilogram of sodium tetrabromphenolphthalein. Compare with Figures 1, 3, and 4.

venous dose, and about one-half the calculated dose for oral administration. He experienced no symptoms whatever. X-ray 4 hours afterward showed that all the pills had left the stomach and three of the 6 taken were still intact. A cholecystogram after 6 hours showed a well outlined shadow of the gall bladder. At the 12 hour interval this shadow was more distinct. Three of the pills were still undissolved, and the shadow had thus been obtained by one-half the intravenous dose.

Again four house officers volunteered to act as subjects to test this new method. One-half gram pills with a double coat of salol were used. A light supper was taken and then 0.1 gram per kilogram of body weight was given in doses divided over an hour or more. None of the subjects showed any definite symptoms except that one had a free bowel movement a few hours after taking the drug. Guiac tests and microscopic examination of the stools were negative. Twelve-hour roentgenograms showed distinct gall-bladder shadows in all the subjects.

Further tests. Following this preliminary trial the test was repeated on 12 other supposedly normal subjects; and then was utilized for diagnostic purposes in 50 patients. By fluoroscopy it was found that with the double salol-coated pills a large proportion of them went through the alimentary tract without being dissolved. Even with single-coated pills some of them passed through. Probably the reason for this was that the pills were made by hand and a uniform salol coat could not be applied.[1] In spite of this fact, however, definite gall-bladder shadows were produced in 93 per cent of the normal subjects and 65 per cent of the patients. In a small number of cases the films were poor because the patient could not hold the breath. A number of the others who did not show shadows gave clinical evidence of gall-bladder disease. One of these proved to have a pathological gall bladder at operation. The absence of a shadow by the intravenous method has meant a pathological condition of the gall bladder in 100 per cent of our proved cases (6). On the whole the shadows produced by the oral method were less dense than those by the intravenous method with the iodine salt,

[1] A satisfactory product has been evolved by Davies, Rose and Company, Manufacturers of Pharmaceutical Preparations, 24 Thayer St., Boston, Massachusetts, to whom we are indebted for valuable assistance in the development of a method for oral administration of the drug.

Fig. 3 (left). Nine-hour film after intravenous injection of 0.05 gram per kilogram of sodium tetraiodophenolphthalein. Compare with Figures 2 and 4.

Fig. 4. Twelve-hour film after oral administration of 0.1 gram per kilogram of sodium tetraiodophenolphthalein in salol-coated pills. Same subject as in Figures 1, 2, and 3.

though there were numerous exceptions to this rule (Figs. 5 and 6).

Because of the fact that the shadows by oral administration of the drug are somewhat faint, the roentgenographic technique must be exceptionally good and particular pains taken to eliminate respiratory movements which tend to erase the shadows. The patient should not be told to take a deep breath, but a moderate breath—one cannot hold the diaphragm perfectly still after filling his lungs to the limit. Furthermore, reliance should not be placed on a single exposure but several should be made at each interval. All this is important since the absence of a shadow, granted perfect technique, almost certainly indicates cholecystic disease.

We do not wish, however, to overemphasize the lessened density of the cholecystograms by the oral method for many of them compare favorably with those obtained by the intravenous method of giving both sodium tetrabromphenolphthalein and sodium tetraiodophenolphthalein. This is illustrated by comparing Figures 2, 3 and 4, which show roentgenograms of the same normal individual in whom all three methods were employed.

It is of interest to note here the difference in the subject's symptoms with the three methods. After the bromine salt injection (Fig. 2) he vomited and was quite ill; after the iodine salt injection (Fig. 3) he felt sleepy and somewhat weak; but after the iodine salt by mouth in pills (Fig. 4) he felt no symptoms whatever.

MANAGEMENT OF THE PATIENT

The patient does not have to be hospitalized in order to carry out the test, in fact he can proceed with his usual activities. Five-grain salol-coated pills are issued, enough to amount to a dose of 0.08 gram per kilogram of body weight (from 3.5 to 6.5 grams). Not more than 20 pills are given. Since the salt seems to be harmless in this form, a large dose is given in order to insure shadows. A light supper of bread and tea, coffee, cocoa or milk is allowed, and starting at 8 or 9 o'clock p.m., four pills are taken every 15 minutes with half a glass of water, until the whole number is

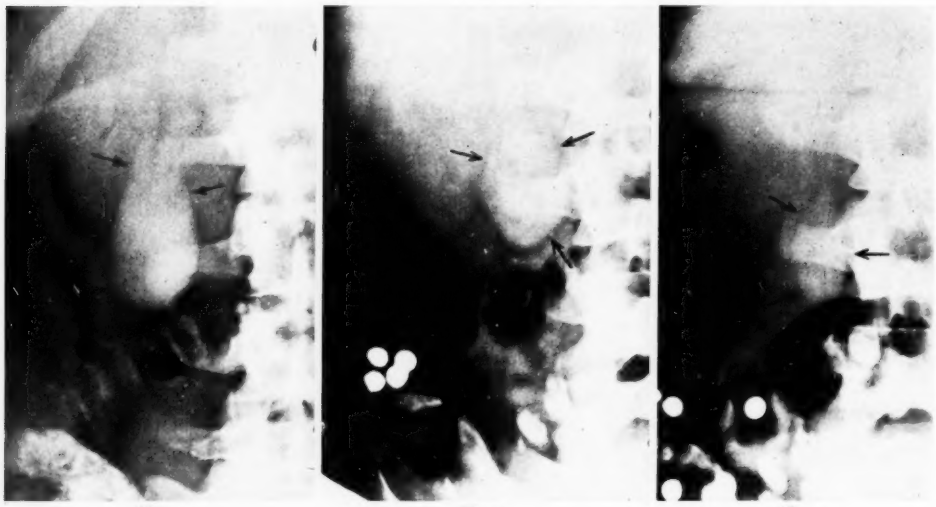

Fig. 5. Fig. 6. Fig. 7.

Fig. 5. Twelve-hour film after oral administration of 0.1 gram per kilogram of sodium tetraiodophenolphthalein in salol-coated pills. This shadow is as clear-cut as we have obtained by any method.

Fig. 6. Twelve-hour film after oral administration of 0.1 gram per kilogram of sodium tetraiodophenolphthalein in salol-coated pills. Note the presence of 4 undissolved pills in the cæcum.

Fig. 7. Fourteen-hour film on same patient as in Figure 6, taken 45 minutes after a meal. Note the marked diminution in size of the shadow of the gall bladder during digestion of the meal.

exhausted. The patient lies in bed on his right side during the period of taking the pills and for an hour or more thereafter. The next morning the patient comes to the X-ray department and roentgenograms are made 12 and 15 hours after taking the pills, no food being eaten meanwhile. After the 15 hour film the patient eats a meal, and an hour afterward, more roentgenograms are made. The purpose of these films after the meal is to see if the gall bladder shrinks down during digestion which indicates that the gall-bladder wall maintains its normal contractility (Figs. 6 and 7).

SYMPTOMS AFTER THE SALT IS TAKEN

Of 44 persons thus tested whose symptoms were recorded, 27 had no symptoms whatever; 5 vomited one to three times; 5 had a mild diarrhœa; 7 had slight nausea. These reactions were not so severe in their effects upon the patient as those which sometimes come after intravenous injection of the salt. The vomiting with the oral method is probably due to gastric irritation by the drug on account of imperfections in the salol coat of the pills, or possibly to the salol itself; while the vomiting with the intravenous method is probably toxic.

In general the effect on the patient is much less noticeable with oral than with intravenous administration. After the former the patient, in most cases, feels perfectly well, while after the latter he often feels somewhat enervated.

There is one caution which should be observed in the oral administration of sodium tetraiodophenolphthalein in salol coated pills. Salol is decomposed in the intestine into salicylic acid and phenol, and with the large dose of salol given in the coating of the pills there is some danger of phenol poisoning. This is apparently slight, however, since the maximum amount of salol ingested would be about 20 grains and none of the 66 individuals in our series showed symptoms of phenol poisoning even though no measures were taken to counteract its effects. We would advise, however, that a dose of magnesium sulphate be given after the last roentgenograms to neu-

tralize any phenol present and to remove the undecomposed salol from the intestine.[1]

More experience will be needed before final conclusions can be reached in regard to the comparative value of the oral and the intravenous methods of giving sodium tetraiodophenolphthalein for cholecystography. Both methods may be capable of improvement, but at present the oral method has several important advantages. Some of these are: that it is convenient, both for the patient and the physician; that it can be used by any roentgenologist in his office; and that in general it gives fewer troublesome symptoms. The advantages of the intravenous method, on the other hand, are that it gives somewhat better shadows, that it is better controlled, and perhaps more dependable.

With our present knowledge of the oral method for cholecystography, we would suggest that patients suspected of having gall-bladder disease first be given the drug by mouth. If a normal, clearly outlined shadow which diminishes rapidly in size during digestion is obtained (Figs. 6 and 7), the probability of gall-bladder disease is slight. If, on the other hand, the shadow is imperfect or absent (provided the technique has been good) then an intravenous injection of the drug should be made in order to confirm the findings. The results to date by the intravenous method have yielded correct diagnoses in 95 per cent of our proved cases (6).

[1]The manufacturers are now making the pills with a coating of stearic acid which makes this unnecessary.

SUMMARY

The oral administration of sodium tetraiodophenolphthalein is being used in this clinic for cholecystography in the form of pills coated with salol in syrup of Tolu.[1]

Cholecystograms have been produced in 93 per cent of normal subjects by this method. We advise the use of the oral method first in cases suspected of gall-bladder disease, to be followed by the intravenous method in the few instances in which the result with the former is not conclusive.

The advantages of the oral method are that it relieves many patients of the hospitalization necessary for the intravenous method, and that it causes them very little inconvenience and few unpleasant symptoms.

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Fig. 1. Umbilical hernia with obese and relaxed abdominal wall, and diastasis of recti.

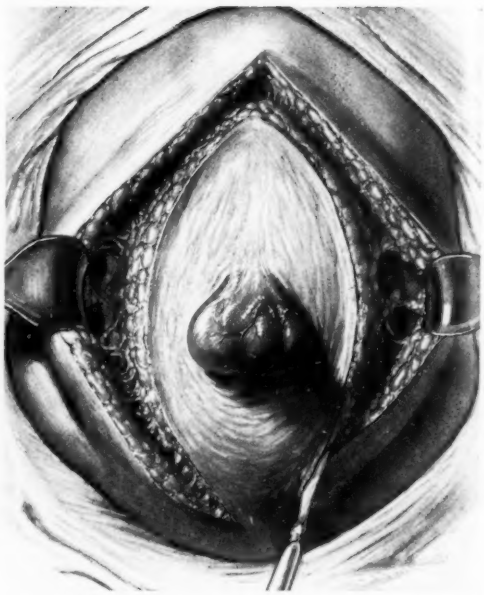


Fig. 2. Umbilical hernia. Skin incision with excision of redundant skin and fat. Approach to hernial sac.

Fig. 3. Hernial sac opened, exposing contained intestinal coils and omentum.

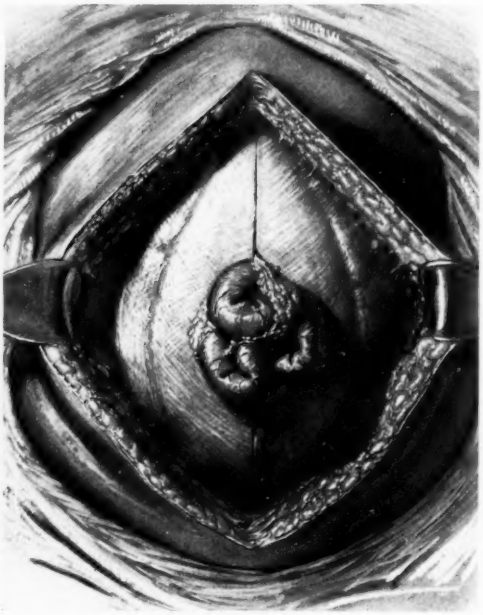


Fig. 4. Vertical division of aponeurosis. Wide diastasis of recti shown.

Interdigitation in the Repair of Large Ventral Hernias with Observations on Lipectomy.—W. Wayne Babcock.

DEPARTMENT OF TECHNIQUE

INTERDIGITATION IN THE REPAIR OF LARGE VENTRAL HERNIAS WITH OBSERVATIONS ON LIPECTOMY

By W. WAYNE BABCOCK, M.D., F.A.C.S., Philadelphia

IN the operative treatment of ventral hernia, it is not always easy to obtain an enduring closure of the defect. Peculiar problems of the individual case are not to be met by a single method of operation. The surgeon, versatile in expedient, who selects the procedure best adapted to the operation in hand, should have the smallest number of recurrences.

Frequently, the sac is quite thick and strong and if sacrificed, tissue is lost that might give added support, and that compares well with a transplant of fascia lata. With a large diastasis, the stretched aponeurosis between the recti may be used to reinforce the union. A method of using the aponeurosis or sac by cutting it into ribbons, which are interdigitated across the wound, is herewith presented. The effect produced resembles that from interlacing the fingers of the two hands across the abdomen. We have occasionally used this method for several years past, and have been

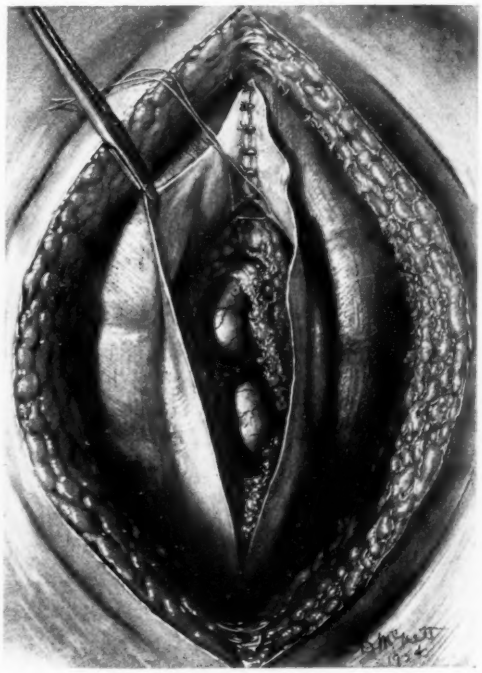


Fig. 5. Approximation of sheaths of recti with eversion of sero-aponeurotic flaps. A continuous suture of chromicized catgut is often used instead of interrupted sutures.

Fig. 6. Recti opposed. Transverse division of sero-aponeurotic flaps into broad ribbons, completed on the left side.

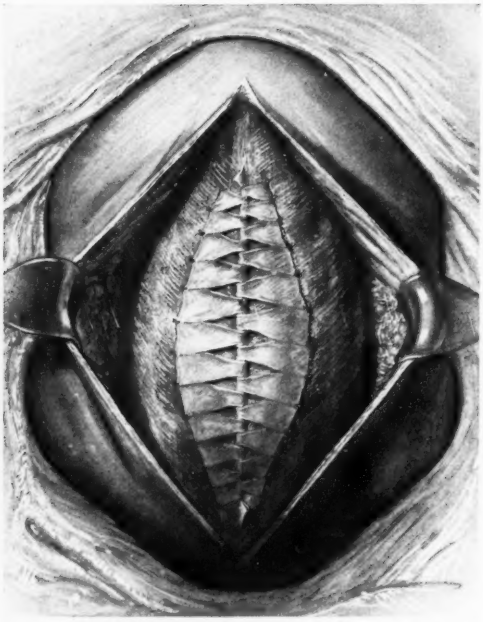


Fig. 7. Ribbons formed from left flap of aponeurosis and sac carried to the right, those from the right flap to the left, interdigitated, and fastened in position by interrupted sutures.

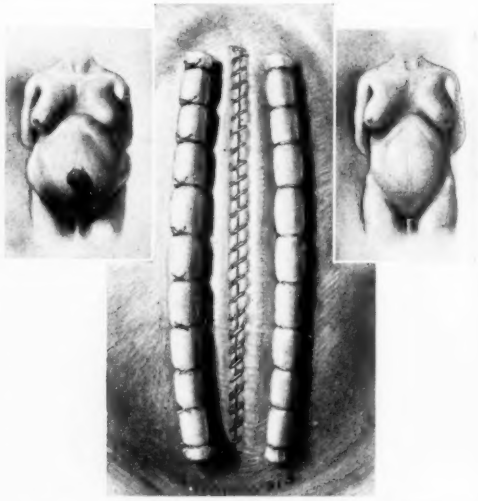


Fig. 8. Completion of skin closure. Vertical mattress tension sutures of silkworm gut tied over dental cotton rolls. Skin approximation by continuous horse-hair sutures. Inserts show condition before and after the operation.

impressed by the strength of the closure and its advisability in selected cases. It may be employed for certain lateral and transverse defects, as well as for large median vertical openings.

In the median defects, it is advisable first to bring the recti in apposition, if this can be done without undue tension. A thick, resisting and muscular abdominal wall without diastasis is most important for visceral support. The operator, who has had his hand in the abdominal cavity of a patient straining under anæsthesia, will have been impressed by the great intra-abdominal tension produced by contraction of the parietal muscles and the support that this pressure gives.

LIPECTOMY

The removal of redundant skin and fat is often an important part of the operation. Lipectomy is well borne by the young, but the elderly, obese patient, particularly one with an associated myocardial degeneration, is in danger of intestinal obstruction or acute cardiac failure if the capacity of the abdomen is greatly reduced. The removal of the conventional transverse ellipse of skin and fat broadens the abdomen and produces unsightly projections at the ends of the wound. To improve the contour, we have excised smaller vertical ellipses of tissue, at each end of the large ellipse (Fig. 10). The removal of a vertical ellipse of tissue, however, usually gives a better abdominal contour (Figs. 12) than the transverse resection.

In many patients, there is such sagging of the tissues of the anterior abdominal wall that the combination of a large, median, vertical with a lower, transverse, elliptical excision, as shown in Figure 13, is to be preferred. An objection to the operation is the two angles where three lines of suture meet. At this point some necrosis may occur, particularly if the skin has been greatly undercut.

TECHNIQUE

In the interdigitation method, the sac is exposed in the usual way. If the sac walls are thick enough to have supporting power, the sac is opened in the long axis of the wound, the edges turned back, and the margins of the hernial ring united by continuous or by interrupted sutures from the peritoneal side as shown in Figure 5. The redundant flaps from the sac wall, or aponeurosis, are now split into parallel ribbons, about 2 centimeters in width, as shown in Figures 6 and 7. The ribbons are interdigitated across the united edges of the her-

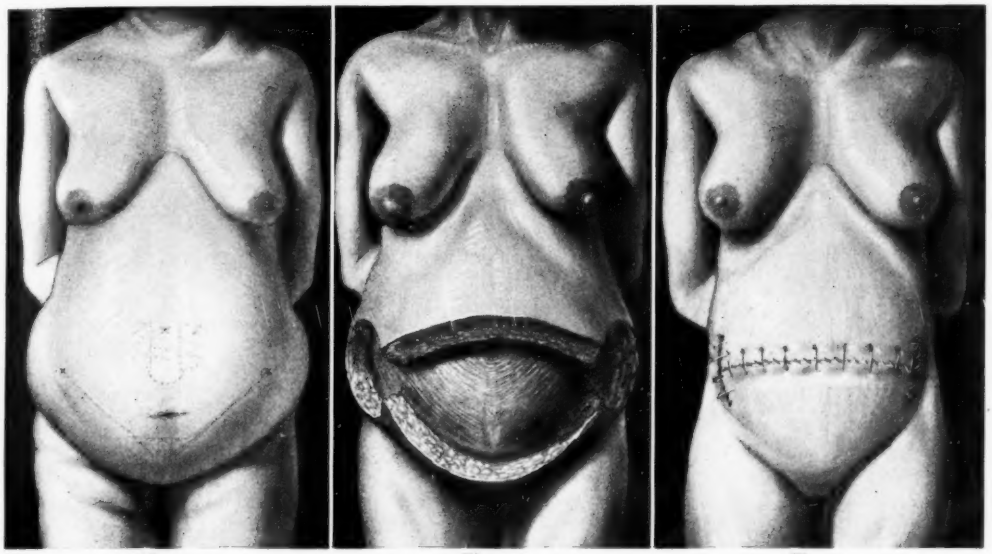


Fig. 9. Fig. 10. Fig. 11.

Fig. 9. Relaxed and sagging abdominal wall, showing the displacement of the umbilicus.

Fig. 10. Transverse lipectomy with the removal of additional lateral ellipse of skin and fat to improve the abdominal contour.

Fig. 11. Wound closure after lipectomy.

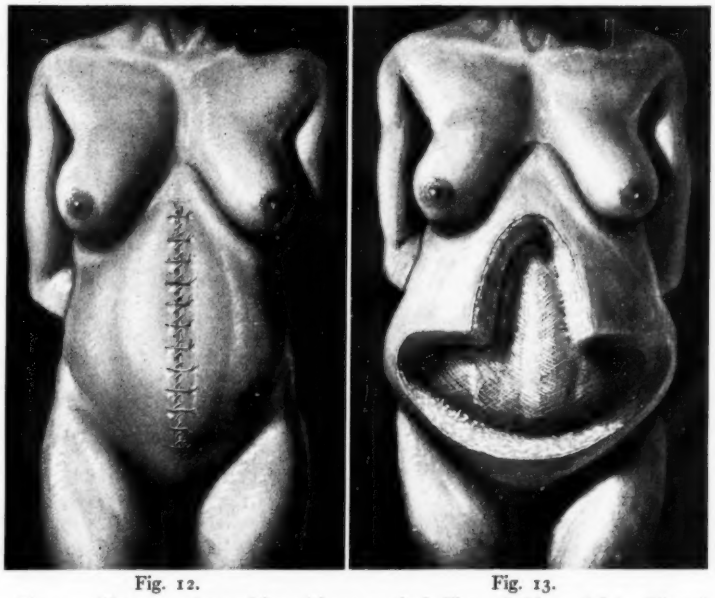
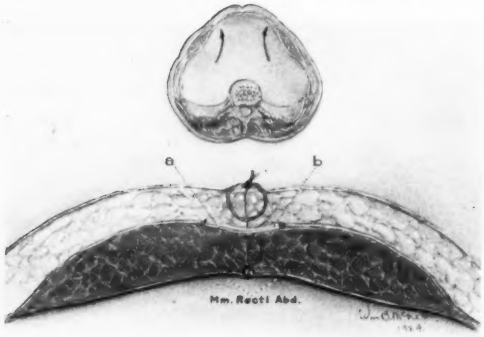


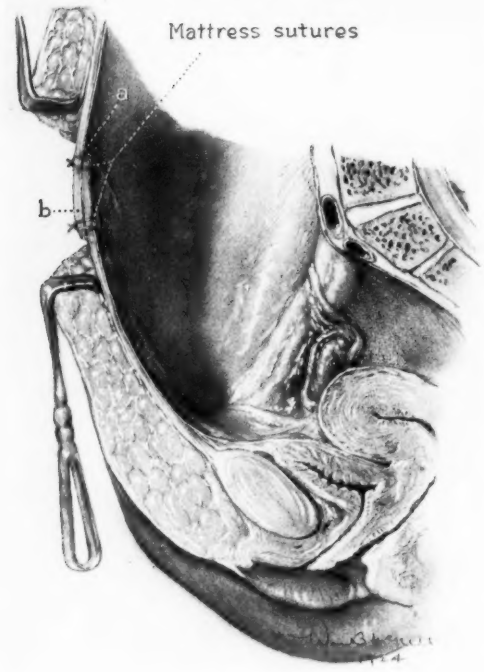
Fig. 12. Fig. 13.

Fig. 12. Lipectomy by excision of large vertical ellipse of skin and fat. Wound closure.

Fig. 13. Combination of transverse and vertical lipectomy often desirable to shorten the anterior abdominal wall, as well as to reduce the redundancy over the hips.



a.



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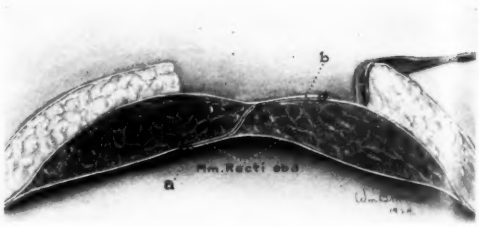

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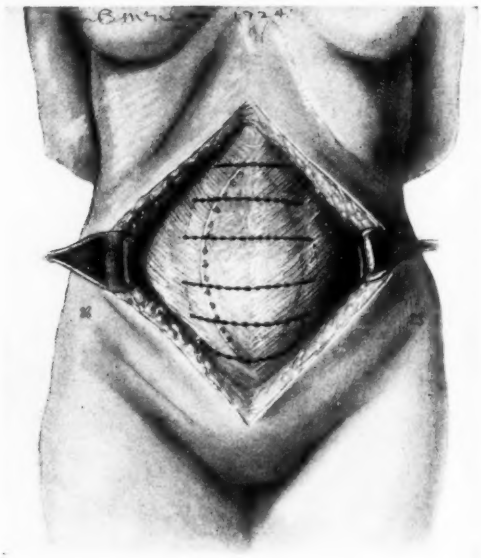


d.

Fig. 14. Conventional methods of deep closure for ventral hernia.

a, Abdominal wall separated into component layers which are united separately with imbrication of the aponeurosis.

b, Mayo operation for umbilical hernia. Wide vertical imbrication. Recti not apposed.

c, Wide lateral imbrication with approximation of recti.

d, Reinforcing continuous suture of fine silver chain. While this chain, like silver filigree, will eventually break in a number of segments, it yet will give desirable support.

nial ring and are fastened in position by sutures of chromic catgut or other material. With a large sac the ribbons may be 10 or more centimeters in length, and when grown adherent give a very strong closure. If the abdominal walls are unusually weak, an additional reinforcing suture by fine buried silver chain may be considered, but rarely should be necessary where interdigitation is feasible. Hæmostasis should be as perfect as possible. In the skin closure, supporting mattress sutures, tied over rolls of gauze or dental cotton rolls, after the plan of the obsolete quill suture, are valuable (Fig. 8). The roll of cotton or gauze does not produce maceration or pressure necrosis, as do buttons, rubber tubes, metal plates, and the like, and the tension at any time may be reduced by removing part or all of the roll.

CONCLUSION

Interdigitation is offered as an additional method of supporting the defective anterior abdominal wall. It is not a universal method, and often it is not applicable. In correcting a ventral hernia, the wise surgeon will select what is best for the particular case, not forgetting recognized methods such as closure in layers with imbrication (Fig. 14a); closure by wide vertical overlapping of the aponeurosis, as suggested by William Mayo (Fig. 14b), by a wide transverse overlapping, or the reinforcement by fascial transplants or sutures of fascia; or even by alien support of silver chain, filigree, or other material.

ACUTE INFECTIONS (SPECIAL REFERENCE TO PELVIC INFECTIONS)[1]

By THOMAS J. WATKINS, M.D., F.A.C.S., Chicago

THE subject of infections especially related to the pelvis is too large for detailed discussion. I shall endeavor in this short article to stress some very important points in the treatment of infections and to emphasize the part taken by Nature in combating bacteria.

Infection not inflammation. It is important to differentiate clearly between infection and inflammation, as one is the cause and the other the result of disease. The nomenclature of diseases should be made upon an etiological basis. Infection is a disease and is essentially destructive to the body; inflammation—"itis"—comprises the reactions in the tissues of the body to the infection and is intentionally protective. The serious phases of infection are largely concerned with the fluids of the body; inflammatory reactions occur in the tissues of the body. Infection has always a definite meaning whereas "itis" is indefinite as it may or may not be infective in origin. This error originated because inflammation and "itis" were established before much was known of infections—when the disease was considered a local malady. For some years in my teaching I have employed infection instead of inflammation or "itis" and have been much impressed with the benefits derived from the use of this change in nomenclature. Why continue to confuse cause and effect?

Infection is a battle between the body and invading pathogenic organisms. It is interesting and possibly valuable to note that the body reacts to invading bacteria much as a community in times of war reacts to the invasion of a foreign enemy. In both instances there is an increased local activity. The changes in the blood vessels are much the same as the changes in the lines of transportation in time of war. Leucocytosis is comparable to mobilization. Round cell infiltration, plastic exudates, and adhesions have characteristics similar to fortifications, wire entanglements and the like. In both instances serious damage results when the fighting forces are cut off from the base of supplies—in war, death of soldiers; in infection, death of leucocytes—suppuration. The local effect of disturbed nutrition is a big factor in the tissue pathology of infections.

Not long since tissue pathology predominated the interest in medicine. The work of Louis Pasteur, and those who have followed him in the study of infection and immunity, have demonstrated that the more serious actions and reactions of infections occur in the fluids of the body. The battle between the body and the invading bacteria is essentially a naval and not a land engagement. This is especially emphasized by the accomplishments in serum diagnosis and therapy, and by the acquired immunity following many of the contagious diseases.

Influence of local inflammatory reaction to systemic infection. This suggests numerous questions:

1. How much does the tissue reaction limit the extension of the infection?
2. How much does it aid in the destruction of bacteria?
3. May it provide a media for the growth of bacteria?
4. How and to what extent does the presence of pus modify the effect of the local inflammatory reaction?

These questions are of special interest to the surgeon as surgery is largely concerned with tissue pathology. The knowledge obtained from laboratory research and clinical observations indicates that the local inflammatory reaction is of much less importance than the systemic infection and that recovery is chiefly the result of the de-

[1] Abstract of address before Columbus Academy of Medicine, November 17, 1924.

velopment of a general immunity. Some exceptions obtain, such as in superficial mucous membrane infections and in the presence of anatomical peculiarities, such as the appendix. I shall not attempt to answer these questions further except indirectly under the treatment of some pelvic infections.

TREATMENT OF INFECTIONS

In the battle between the body and invading bacteria, treatment may directly destroy the bacteria by means of specific therapy or indirectly injure them by giving aid to the body—which is known as, for want of a better term, sustaining body resistance. In pelvic infections no specific therapy of much if any importance has been found. The serum therapy for pelvic infections has been confined chiefly to the treatment of puerperal infection and it has not proved of any special value.

The value of proteids in acute pelvic infections, such as the injection of sterile milk, is still in the experimental stage. The same seems to be true of the intravenous use of antiseptics, such as mercurochrome and anilin dyes. We have not had sufficient experience to pass judgment upon these remedies. The work of Piper, Hugh Young and his assistants has created an interest in intravenous antiseptics. It is significant to note, however, that there is not much evidence of their usefulness in the treatment of streptococcic infections. On the other hand, they have seemed to be of real use in some cases of staphylococcus and colon bacillus infections.

Vaccines. It would seem illogical to use vaccines in acute pelvic infections, as it would mean the introduction of dead bacteria into the body while the system is flooded with dead bacteria. Vaccines may be useful at times to stimulate local reaction in chronic cases.

What is known as supportive treatment consists chiefly in supplying the infected body with things which are known to be most important to the well body. This type of treatment has been well established in the cure of tuberculosis. The outdoor treatment is probably just as important in other infections as in tuberculous infections. The more acute the infection, probably the greater the need of this type of treatment.

Surgery. The treatment of puerperal infections has become or should become almost non-surgical. There is nothing except a dangerous tradition to recommend curettage or instrumentation of the inside of a puerperal uterus. The danger consists largely in disseminating infection, in opening the uterine sinuses, and in dislodging septic thrombi in the uterine sinuses which often result in septic embolism.

Our mortality and morbidity in puerperal infections has been enormously reduced since curettage, intra-uterine douches, and the like have been abolished. In fact, the prognosis of puerperal infections should be *excellent* except in the very virulent type of streptococcic infection and these are relatively uncommon.

Of late little has been said about incision and drainage of the pelvic veins in acute puerperal phlebitis, which means that this operation died a well deserved natural death. The incision and drainage of puerperal exudates is indicated only in the very exceptional case in which the abscess has become superficial, is distinctly fluctuating and in which it can be evacuated without much disturbance to the patient.

In puerperal pelvic exudates there is often little or no suppuration. When abscesses are present they are usually multiple and often inaccessible and are thus not favorable cases for incision and drainage. Experience has taught that the puerperal pelvic exudate nearly always disappears entirely by spontaneous absorption and that the exudate does not tend to get smaller until general immunity is established, after which absorption is usually rapid and complete. Puerperal infections early become essentially systemic infections and then recovery has to depend upon the development of a general immunity.

Non-puerperal infections of the fallopian tubes. The treatment of acute infections of the fallopian tubes has also become largely non-surgical. Observation has demonstrated that many of these patients recover without operation, even in cases of abscess in the tubes. The danger of such tubes rupturing and producing a generalized infection of the peritoneum has been found to be largely imaginary. There is little or no need for surgery for acute infections of the fallopian tubes. Surgery is required at times for the residues of infection. It is probably conservative to state that about 50 per cent of all patients with infection of the fallopian tubes, if given good medical care and sufficient time, will recover without operation. In these cases, however, it is important to give attention to the tissues which are liable to harbor infection, namely, Skene's ducts, the glands of Bartholin, and the mucosa of the cervix. Such attention will greatly lessen recurrences of the infection in the tubes, care of course being taken that these patients are not re-infected. Recovery as used above does not mean complete restoration of the function of the tubes, neither is the function of such tubes restored by surgery.

Incision and drainage of pelvic abscesses. This is seldom done compared to the treatment in vogue some years ago. It is utilized in some exceptional cases with the same reservations as were enumerated under puerperal infection. Unless the abscess is large and superficial it is generally better to postpone surgery until immunity is established and then to do sufficient surgery if need be to give good assurance of a cure.

CONCLUSIONS

1. Infection should be definitely distinguished from inflammation. Infection is a disease—an enemy of the body; inflammation is neither a disease or an enemy but is an ally of the body.

2. Infection is a battle between the body and invading bacteria.

3. The conflict takes place chiefly in the fluids of the body—is essentially a naval battle.

4. The study of strategy is the study of immunity.

5. The treatment of acute infections should be chiefly medical, with few exceptions, as surgery is essentially concerned with tissue pathology and in these cases the condition of the t ssues is of secondary importance.

PHALANGIZATION OF THE FIRST METACARPAL

By Dr. GUILLERMO BOSCH ARANA. Buenos Aires. Argentina
Professor, Faculty of Medicine, Member of the Faculty of the University, and Surgeon of Piñero Hospital

WE understand by the term phalangization (from the Greek phalangis) any surgical intervention which has for its object the construction of a stump which will serve as a finger.

My patient was a distinguished colleague who ventured on a perilous boat trip on the Rio Negro, and in holding on to a rope caught his right thumb in the fine wire cable. The strong current in the river threw the boat so that the cable formed a lasso around the base of the thumb, the knot tightened with such violence that the thumb was amputated in a regular guillotine manner. The whole thumb was cut off above the metacarpophalangeal joint, the thumb itself falling on the edge of the boat. The treatment extended over a long period of time with great care as my colleague was desirous of preventing synovial infection. Fortunately, the wound healed in due time, under very good conditions, but the accident nipped in the bud the man's aspiration and enthusiasm to become a surgeon.

Eight months after this unfortunate trip, the patient sought my advice. The interdigital fold between the thumb and the index finger was normal, but it stretched to the cicatricial skin of the stump of the amputated finger. When the hand was fully extended and viewed from the side of the palm, the internal and external edges were seen to be parallel. The skin of the thenar eminence was quite normal, the fleshy pulp being rather atrophied, but sensitiveness was retained. Examination of the right hand showed the phalanges of the thumb lacking, and when the hand was stretched wide, the outlines of the tendons as well as the prominence of the first metacarpal were visible.

In spite of the traumatic amputation of the thumb, both active and passive movements of the first metacarpal were maintained, that is to say, the power remained to abduct and oppose the stump, functions characteristic of the muscles which form the thenar eminence. The short metacarpal stump was useless when the patient attempted to take hold of objects, and the physiological grip of the hand was destroyed by the loss of one of its most important branches, the thumb. The hand, therefore, had to be used as a hook or as scissors. The most important functions, opposition and grip, indispensable in our profession, which do not require manual force but do require delicacy and gentleness for ordinary acts of vital importance, were impossible and my new friend was greatly distressed. His natural instinct was to hide the physical defect, and he constantly kept his hand in his pocket.

In the 8 months that had elapsed since his accident he had learned to write and to use the left hand dexterously and to his personal satisfaction, but he had not become resigned to the physical torture which was undermining his morale. The ordinary prostheses for the thumb could not be used in his case for these were capable of neither suspension nor adaptation. The artificial finger could neither take hold nor resist pressure even when a glove was worn to keep the artificial finger in its place.

After an anatomical and physiological study I proposed to him that we intervene surgically and separate the first metacarpal from the second, and thus give a grip to the hand. The first metacarpal with its power of adduction, abduction, and opposition, once free from the second, and phalangized, would give a short thumb, but one which could be used to seize objects. On the other hand, the resulting stump would form a base for an artificial finger.

The roentgenogram showed the condition of the metacarpal, sesamoid bones, and a thin layer of diarthrodial cartilage of the phalanx (Fig. 1).

TECHNIQUE

The idea of the operation was accepted with enthusiasm. Operation was performed under truncular anæsthesia of the forearm and circular subcutaneous anæsthesia of the hand.

First step. Dorsal fleshy tissue. A triangular area of the dorsal fleshy tissue was outlined. This area began at the outer surface of the hand near the metacarpophalangeal joint of the second

Fig. 1. Roentgenogram showing condition of patient's hand before operation.

finger, extended toward the outer edge of the interdigital fold, and then to the inner surface of the metacarpophalangeal joint of the first metacarpal. It was then curved at right angles and continued parallel on the inner side of the large extensor tendon of the thumb to the base of the metacarpal where it was bent a little to the inner side so that it would terminate at the base of the second metacarpal (Fig. 2). Thus this flap had the shape of a right angle triangle the base of which corresponded to the outer surface of the second metacarpal. After the tissue was cut, it was dissected loose together with its aponeurosis, and turned back on its metacarpal base. This exposed the muscular fibers of the first interosseous dorsal space and some arteries and digital veins branching from the radial as they entered the base of the interosseous space (Fig. 2).

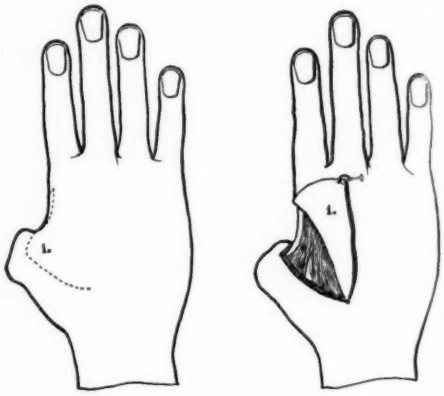


Fig. 2. Line of incision and dissection of dorsal triangular flap with the second metacarpal as a base.

Second step. Fleshy tissue on the palm. Another triangular flap with fleshy pedicle was outlined on the palm. This started at the same spot as did the dorsal pedicle in the vicinity of the metacarpophalangeal articulation of the second metacarpal, extended into the palmar surface and ran almost parallel with the first incision for 5 millimeters. To the outer side of the upward flexion crease of the palm the incision was extended upward to the thenar eminence, 1 centimeter from the upward flexion crease. The pedicle for this flap was formed by a single incision which was a continuation of the incision on the dorsum over the interdigital fold (Fig. 3).

When the skin and aponeurosis of the pedicle of the palm had been removed and turned back

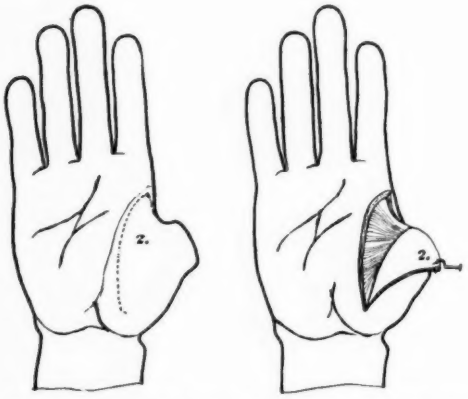


Fig. 3. Line of incision and dissection through the triangular fleshy part of the palm with the first metacarpal as a base.

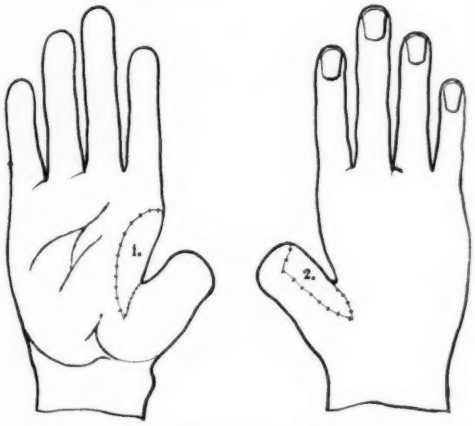


Fig. 4. Skin plastic. 1, Dorsal pedicle; 2, palmar pedicle.

Fig. 5. Stump produced by operation.

Fig. 6. Prosthesis for the thumb.

Fig. 7. Æsthetic result is perfect.

along the metacarpal base of the thumb, the muscular fasciculi of the adductor of the thumb, the vessels and nerves, and some fibers of the short flexor of the thumb were left bare (Fig. 3).

Third step. Muscular resection of the adductor. The adductor muscle was dissected and severed at its sesamoid insertion and was afterward taken up with Kocher forceps. The fibers constituting the metacarpal fasciculus or transverse adductor were dissected down to their insertion on the third metacarpal where they were severed again. By this means we extirpated the whole transverse adductor muscle. Hæmostasis was effected.

Fourth step. Muscular resection of the interosseous space. With the interosseous dorsal muscle a technique similar to that applied to the adductor was carried out; that is to say the muscle was dissected and its osseous insertions were severed on the first and second metacarpal, and then it was freed toward its digital extremity by cutting its tendinous part toward the extensor tendon of the index finger.

These four fundamental steps having been carried out, we were able to sever the relation between the first and second metacarpals, that is to say, we severed the intermetacarpal muscular barriers and rendered the metacarpal of the thumb independent and gave it free action. In fact, the thumb could be moved adductively, by the adductor of the thumb because the carpal fasciculus of the thumb had not been extirpated; it will move abductively through its own muscles which were uninjured; and lastly, it will have oppositional movement because this muscle remains unmodified by the operation.

Fifth step. Skin molding. Maintaining complete hæmostasis of the few insignificant arterioles, we proceeded with the skin molding by carrying the dorsal pedicle toward the surface of the palm thus covering the second metacarpal (Figs. 4, 5). In turn we passed the palm pedicle over toward the back surface thus covering the first metacarpal (Fig. 4, 2). Both pedicles are crossed through the intermetacarpal space, and their edges must correspond with the respective edges of the palm or back of the hand, since the dimensions are noticeably alike, and they must be

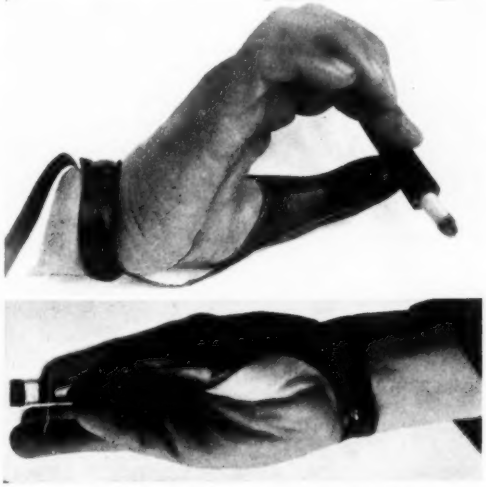


Fig. 8. Abduction is perfect. Fig. 9. Opposition is perfect.

carefully sutured so as to obtain a speedy healing (Fig. 4).

My colleague left the sanatorium and went home where I removed the stitches a week later. Massage and mobilization of the phalangized metacarpal were then started. The stump produced could not have been better adapted for the placing of a thumb prosthesis, the skin-molding was perfect and painless and provided the orthopedist with a mobile, potent, and solid stump capable of performing active and passive movements of the thumb, adduction, abduction, and opposition (Fig. 5).

The phalangized metacarpal may be used without a prosthesis for ordinary purposes, for it provides the patient with a digital forceps, short, but useful in every sense. The hand, however, is not perfect and ideal from an æsthetic point of view, but from a practical standpoint it is entirely useful and perfect and justifies all our aspirations in undertaking the task.

Our friend and colleague wished, as may logically be supposed, to achieve the surgeon's desideratum; to produce an ideal thumb. We were desirous of acceding to his wishes and consequently undertook the reconstruction of the artificial finger which was a complete success.

The prosthesis for the thumb (Fig. 6) was made in collaboration with the orthopedist. The finger was made of felt in a semi-bent position, was mounted on a leather funnel and fitted the metacarpal stump perfectly. The prosthesis was held and supported by a common kid glove finger, specially fitted, which extended over the metacarpal and was fastened with a wrist bracelet (Fig. 6). As the prosthesis is covered with the finger of a glove the æsthetics are perfect, and the loss of the thumb cannot be detected by the most practiced eye (Fig. 7).

In fact, the prosthesis gives action adductively, abductively, and in opposition (Figs. 8 and 9). And if we add to these qualities the fact that the energy developed by the thumb is equal or similar to normal, one is bound to recognize the excellent results attained by the operation which we performed. The patient's own efforts and reeducation in the use of the hand must complete our work.

NEWER METHODS OF TREATMENT IN NON-UNION OF FRACTURES

By R. TUNSTALL TAYLOR, B.A., M.D., F.A.C.S., Baltimore, Maryland

WAR Surgery did much to aid in the advancement of improved methods in industrial surgery in that it afforded vast material for study and research in the repair of the human body. Surgeons, and especially bone surgeons, had to tax their ingenuity in many instances to get restoration of tissue and function.

Perhaps no condition requires more "stick-atedness" on the part of the surgeon and fortitude on the part of the patient, than non-union of fractures. They are often spoken of as pseudoarthrodeses, in that frequently we find a fibrous and not a bony union between the segments. In extensive loss of substance in bone, there is even a fibrosis of tissues connecting the fragments.

These cases naturally are divided into groups of simple and compound fractures or, as they are often spoken of, as closed, and open, infected fractures.

CAUSES OF NON-UNION

As a rule, simple fractures rarely result in nonunion, except when the causative trauma or muscle spasm results in displacement or when subsequent closed reduction interposes muscular, tendinous, or other fibrous tissues, but there are exceptions to this, as will be stated, applying to both closed and open fractures.

The causes of non-union other than the interposition of some non-osseous substance may be summarized, as a deficiency in osteogenetic force or elements (Ollier), or a food deficiency in phosphorus or calcium, or a metabolic abnormality in their deposition at present not understood (McCollum and Peterson), unless it may be due to the absence of vitamines obtainable by heliotherapy from the direct rays of the sun.

Of these, in the writer's experience and opinion, the first named, granted that we have good alignment and close approximation, is, in by far the larger group of cases, responsible for the nonunion and may be explained by an absence of the requisite number of osteoblasts in the field of repair to effect the production of healthy callus and bone deposition in it.

This condition may be brought about by impaired vitality in the individual; fibrosis, eburnation, rarefaction or bone atrophy locally; de-

Fig. 1. Roentgenogram of Case 1 showing that the bone had not fractured but that the wire used in operating for previous injury had fractured.

vitalization of the fragments and vessel occlusion incident to prolonged infection; toxic destruction or inhibition of osteophytes or any condition which may interfere with osteophytic migration from the haversian canals to the seat of the injury.

Ollier[1] was the first to recognize that of all the constituents of bone, the periosteum played the larger part in bone repair and he blazed the trail for subsequent surgical advances by utilizing the periosteum from a tibia on May 13, 1835, to reconstruct a nose and even with infection, this was partially successful.

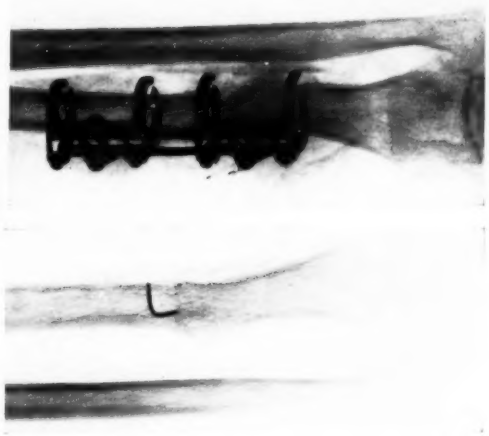
MECHANICAL POINT OF VIEW

Here in America, we have been wont to consider these problems more from the mechanical than from the biological and physiological points of view, largely under the leadership of Albee[2] in bone grafting "periosteum to periosteum, cortex to cortex, and endosteum to endosteum."[3] Perhaps nothing could be more exact as viewed from a craftsman's standpoint than the Albee inlay or sliding graft and many of the results were brilliant, especially with extensive loss of substance in the bone defect. But even mechanically the disproportion between the small size (circumference) of the graft and the host fragments led in many cases, in gunshot wounds with extensive loss of substance, to fracture of the graft with no ultimate union in this disappointing mischance. Frequently union would take place at one end and not at the other, probably from inadequate or too brief fixation of this too mechanical and too little

[1] Ollier. Am. J. Surg., 1921, xxxv, 281.

[2] Albee. Am. J. Surg., 1914, xxviii, 21-26; New York M. J., 1914, May 23, 3.

[3] Ely, L. W. States emphatically that there is no such structure as endosteum in bone make-up but that the so-called endosteal cells are those of the marrow cavity. J. Am. M. Ass., 1924, Aug. 16, 552. Even A. L. Haas admits it is not a membrane that can be peeled off as a definite strip or structure like periosteum.



Figs. 2 and 3. The arm is restored to entire usefulness with no limitation of motion. A piece of the wire was so embedded in the bone that it could not be removed and is seen.

biological or too slow callus-forming method, plus muscle contracture or torsion. Henderson of the Mayo Clinic suggested "massive bone grafts" to meet some of these difficulties.

THE PHYSIOLOGY OF BONE REPAIR

If we consider the physiology of bone repair as seen in surgery, we must admit the conspicuous and almost chief rôle played by the periosteum. Take for examples, osteomyelitis, neither the endosteum nor the cortex play a notable rôle in repair, but the periosteum proliferates and we have the increased circumference known as the involucrum, with necrosis of the central elements, as the sequestrum; or in amputations, if by chance, the periosteum is not cut away at a higher level than the bone cortex, we find subsequently painful osteophytes have formed growing into the stump end from the proliferating bone-forming periosteum, which require removal and stripping back of the periosteum properly. From the medico-legal standpoint, not only of serious import to the surgeon, but to casualty companies as well, that unfortunate condition occurs, more often after elbow fractures, known as myositis ossificans. Through no fault of the surgeon, when the cast is finally removed, he finds an ankylosed elbow. This occurs from tearing loose of periosteum incident to the fracture. Bone proliferation has taken place around the joint and into the muscles, destroying function, and the periosteum is the focus and source of this misfortune. Other

Figs. 4 and 5. Case 2. Roentgenograms showing the condition prior to final operation.

traumatic instances may be cited such as osteomata, osteochondromatosis, and osteochondritis dissecans in joints.

The periosteum. Thus we recognize this chief bone forming function of the periosteum. The external or fibrous layer of the periosteum is chiefly protective and infection resisting, while the cambium, or internal vascular layer, contains with the underlying superficial bone layers, the osteoblastic or bone forming cells.

THE OSTEOPERIOSTEAL GRAFT

It is chiefly to General Henri Delagénière of Le Mans, France, following the suggestive work of Ollier, that we are indebted for the introduction of what he has termed the "osteo-periosteal grafts," by which are meant grafts consisting of periosteum chiefly with a layer of underlying bone the thickness of a ten cent piece. These contain the most abundant supply of osteogenetic osteoblasts, and repair is more sure and rapid.

McWilliams[1] from statistics on 1390 collected cases of non-union operated upon, gives the percentages of successes by various methods as follows:

	Per cent
Bone pegs	95.8
Osteoperiosteal grafts	87.3
End to end ("steppage")	82.5
Inlay	80.9
Intramedullary	76.6
Intramedullary and inlay	60.

In order to be of value for surgical judgment, of course, any analysis of the methods of treatment on non-union cases should be governed by their type, whether of open or closed character; amount of loss of substance; severity, duration, and kind of infection, degree of bone vascularity, amount of fibrosis and deformity, as important factors having bearing on the end-result. In an infected case, even after apparent healing with Dakin solution, in residual scar tissue, there is no time limit to secondary infection from some unrecognizable encapsulated pocket, from which the reconstruction operation may be invaded.

Delagénière's method. Delagénière obtains the osteoperiosteal graft from the tibia after cutting the desired size through the periosteum and with mallet and chisel removing a thin layer of underlying bone. The medulla is not invaded nor is the strength of the tibia appreciably affected, as in the case of the whole thickness bone graft.[2] He reported 296 successful cases. His first operation was on November 29, 1905, when he transplanted an osteoperiosteal graft from the tibia into the forearm (Italian graft) and subsequently transferred this to form a nose. Direct transplant from tibia to radius he did on March 31, 1906.

These grafts are quite pliable and adaptable to various surfaces and curl up when first removed like a sliver of bacon. They can be cut in strips with scissors and applied to bridge the defect like sheathing on a ship or in two or more sections to surround the loss of bone substance in long bones like a sleeve.

Ch. Dujarier[3] reports 100 successes with osteoperiosteal grafts and that "the consolidation was rapid."

CONGENITAL NON-UNION

For congenital absence of bones or congenital (intra-uterine) pseudo-arthroses, the same author in conjunction with M. Perrin reported five successes in arms and legs, some involving both bones in the forearm and leg, using osteoperiosteal grafts. They also presented on March 24, 1920, before the Société de Chirurgie de Paris, two cases of congenital absence, one of a tibia and one of a radius cured by this method.

These writers quote results obtained by three different methods.

1. The pedunculated osteoperiosteal-cutaneous graft of Reichel,[4] "the Italian method" consists of transplanting an osteoperiosteal graft under the skin for some time to insure its nutrition, and then, when it is desired, sewing it in the defect. This method was used not only by Reichel, but by Codivilla[5] and Nové-Josserand[6] "with satisfactory results, but was tedious, as they kept the

[1] Ann. Surg., 1921, lxxiv, 286.

[2] Delagénière and Lewin. Surg., Gynec. & Obst., 1920, May, 441; Delagénière. Bull. d. l'Acad. d. méd., 1922, lxxxviii, 396.

[3] Dujarier, Ch. J. de. chir., 1920, xvi, 31.

[4] Reichel. Cong. all. d. chir., 1903.

[5] Codivilla. XVI Cong. internat. d. méd., Budapest, 1909.

[6] Nové-Josserand. Lyon méd., 1907.

Fig. 6. Case 2. Roentgenogram showing the extensive callus formation and firm union after application of the osteoperiosteal graft and bone clamp.

patients in bed a long time and consolidation was slow." Reichel's case took 15 months, Codivilla's 11 months and Nové-Josserand's 8 months. Nové-Josserand reported 2 cases of congenital non-union, at the Congrès français de Chirurgie in 1922, of 18 and 14 years' duration respectively with restoration and normal development by the osteoperiosteal-cutaneous method and considers it "useful chiefly in the cases of extensive loss of substance" (bone and other structures) and "with tapering fragments."

2. The free graft of Albee was used successfully by Nové-Josserand[1] in two congenital cases of absence of the fibula and in a third "only partially successful." Before the Lyons surgical society in March, 1920, he showed a 7 year old girl cured of a congenital pseudo-arthrosis after two osteoperiosteal operations. Putti reported 13 cases with 11 failures in bridging congenital defects using the fibula of the same or other side (Graffe de Hahn-Huntington).

3. The graft of Delagénière is considered by Dujarier and Perrin as the *treatment of choice* in non-union when the fragments are not widely separated. In 1909 Codivilla of Bologne used the osteoperiosteal graft for non-union in the tibia and cut it in pieces which were tied by catgut around the fragments bridging the defect like boards.

Froehlich[2] of Nancy seems to have been the first to use osteoperiosteal grafts for non-union, in a 4 year old girl. He obtained "union in 2 months and the patient walked perfectly." He reported two other cases progressing favorably and urged the importance of also burrowing into the medulla of the fragments to aid nutrition and hasten repair. He reported in similar cases two successes and two failures at the IX Congress of German orthopædic surgeons.

[1] Nové-Josserand. Soc. d. chir., Lyon, 1914.
[2] Froehlich. Rev. d' orthop., 1910, Jan.

Fig. 7. Case 2. Roentgenogram showing the approximation of the radial fragments. Union there also will be readily obtained.

Mauclaire[3] cured a young man, age 22, who had had an intra-uterine fracture in the lower fourth of his tibia, by an osteoperiosteal graft.

Dujarier[4] reports 70 cases of forearm fracture with non-union, of which 65, or 90 per cent, were cured by the osteoperiosteal method and of these 15 had both bones fractured.

Thus we see that in France this method has been extensively employed by various surgeons with success.

NEGLECT OF THOROUGH MECHANICAL FIXATION

The American surgeon, in the writer's opinion, would believe except when there is very little loss of substance or close approximation of the fragments and easy maintenance of alignment, that the osteoperiosteal graft alone seems too flimsy to offer or maintain support and that it is not mechanically correct enough to maintain fixation and immobilization even with a well applied plaster cast, such as the French rely on. This would seem especially true in non-union of forearm fractures, when the muscle spasm, especially of the pronator radii teres and pronator quadratus, often even within a snug plaster cast, produce a torsion and separation of the fragments.

METAL IN BONES

American surgeons are getting away from the use of metal in fractured bones, as it undoubtedly causes osteoporosis, bone absorption and atrophy, and interferes with healing and union. Lane and Hey-Grove in England and Tuffier, Alglave, and Hallopeau[5] in France are the chief exponents of plating, but all are pretty well agreed that in old infected cases osteomyelitis with non-union often results in such mechanical fixation. In simple fractures with ample muscular covering, plating may at times be justified as are small wire or screw fixation in more superficial bones, if other means fail. Bands and clamps do not interfere less

[3] Mauclaire. Soc. d. chir., Par., 1921, July 6.
[4] Dujarier. J. de. chir., 1918, xv, 333.
[5] Soc. d. chir., Par., 1920, xlvi, 1080.

with bone nutrition than does metal *that goes into the substance of bone.*

With these thoughts and an experience based upon them in mind, I believe that it may not be amiss to report a type of each case of non-union, namely closed and open fracture of the forearm, in which the problem seemed to be to stimulate osteogenesis, which was lacking, and to maintain perfect alignment even in the open case, in which there was extensive loss of substance, prolonged suppuration and fractures of both bones.

This work was undertaken, quite independently by the author at a time, when he was not familiar with Delagénière's method. It was based on surgical reasoning.

CASE 1. R. G., a young officer in the A. E. F., was caught between two motor lorries in France and suffered a fracture of the radius in the middle third. His arm was at once put in a plaster cast, but union failed to occur. Some 2 months later he was operated on by one of the most skillful of the American surgeons and the bones were wired, so that perfect apposition and alignment was secured and he was again put in a cast. After 5 weeks this second cast was removed, but no X-ray was made to confirm what was apparently firm union. He noticed that the arm was appreciably weaker than before the accident, but performed his usual duties, however, saving the arm as much as possible. In February, 1924, following a heavy snowstorm in which an automobile "got stuck," he endeavored to help push it out, when he felt his arm give way and "break" at the seat of the old fracture. On presenting himself to me and after a study of the X-ray, it was found that the bone had not fractured, as there had been no union, but the wire had (Fig. 1). Operation was done the latter part of February, a few days after the last mishap, and an osteoperiosteal graft 5 by 1½ inches was obtained from the tibia in the following manner. With the smallest, thin Albee cross-cut electric saw, about three-quarters of an inch in diameter, following the incisions through the periosteum, which had been made with the scalpel, of the desired size, an incision was made superficially into the bone of no greater depth than 2 millimeters. It was then easy to remove the periosteum and this *uniform* layer of superficial bone with a mallet and chisel *without splintering*. This rolled up and was placed in a sterile handkerchief. Prior to this the fracture had been exposed, fibrous and eburnated ends were removed down to vascular bone, the covering periosteum for 2 inches proximally and distally was scarified around each and the osteoperiosteal graft then obtained was wrapped around as a sleeve almost entirely covering the radius in this region, with the periosteum external. Anticipating the mechanical requirement of fixation in alignment, a Smith bone clamp had been secured and with this applied external to the osteoperiosteal graft, which was easily and expeditiously done, no anxiety was felt that either the bone fragments or the graft would slip or that the blood supply or nutrition of the bone would suffer. The skin was closed with subcuticular No. 2 chromic catgut. Union was quite solid in 3½ months, and it only remained to remove the bone clamp and resuture the skin. The arm is restored to entire usefulness with no limitation of motion (Figs. 2 and 3). A piece of the wire was so imbedded in the bone it could not be removed and is seen.

CASE 2. C. W. E. S. A young lieutenant with our Army in France was wounded at Chateau Thierry, in the forearm by shrapnel. He lost some 4 inches of the radius and more of the soft parts. After débridement and Dakinization, several attempts at bone grafting were made in France and subsequently in the United States, so that the operation about to be reported was the fifteenth attempt that had been made at reconstruction. As is the case with the majority of patients who have loss of substance of the radius, this man had an extremely bowed arm and a marked prominence of the ulnar styloid as a result of muscular contracture, chiefly the supinator longus and flexor carpi radialis. The concavity was on the radial side. He had had a resection of the ulna by *steppage* done in an attempt to overcome this bowing and equalize somewhat the disparity of the length of the two bones. Unfortunately, while union was progressing and well advanced, the patient's arm although in a cast dropped during sleep over the side of his bed and he refractured the ulna at the operative site, probably by torsion (i. e., pronation). These fragments were then wired, resulting in bone atrophy, absorption, and necrosis. On the radius he had had sliding grafts, inlay grafts, intramedullary grafts, etc., with only in one instance union at one end of the graft. In one hospital he blamed undue force in removing a cast as responsible for fracture of an inlay graft. Because of the bowing and deviation of the distal fragment of the radius to the ulna side, it was impossible to get alignment of the ulna and radius at the same operation, although this had been attempted, with suture by kangaroo tendon, which, intramedullarily, had acted as a fibrous interposition preventing bone union. Thus this young man, worn out with surgery, besought me and Dr. J. M. T. Finney, who kindly saw the case with me in consultation, to take the arm off. I told him of my hopes and belief in the osteoperiosteal graft and bone clamp as a last means of helping him. Figures 4 and 5 show his condition prior to this final operation and the extensive rarefaction, bone atrophy, and necrosis following the use of silver wiring. Figure 6 shows the extensive callus formation and firm union after the application of the osteoperiosteal graft and bone clamp. This operation was done on March 31, 1924. Union was firm and the cast was removed July 15 and the bone clamp taken out August 19, 1924. Approximation of the radial fragments is so close that after removal of the eburnated ends not much apprehension is felt that, by means of an osteoperiosteal graft, union there also will be readily obtained (Fig. 7).

Dr. H. A. Peterson, of the Johns Hopkins Hospital, kindly made for me a determination of the calcium and phosphorus coefficients in these cases before union, and reported that they were just about normal. Thus we can attribute union to the osteoperiosteal grafts rather than to diet, although I urged that the diet be freely of calves' liver (for phosphorus) and green vegetables, plus calcium carbonate and cod liver oil as medicines.

TWO STAGE OPERATION IN INFECTED NON-UNION CASES

M. F. Forrester-Brown[1] of Edinburgh emphasizes what has been the practice of many of us and to which we agree, that reconstruction of old infected non-union cases should be operated on in two stages. The first operation is to remove all scar tissue, the result of infection, in the soft parts

[1] Brit. J. Surg., 1921, ix.

and eburnated or fibrosed bone to prevent sepsis and to improve the blood supply; to correct the deformity and thereby prevent unnatural strain after grafting is done; to prevent the likelihood of hæmatomata at the second operation after the graft is in place with its tendency to fibrosis or infected hæmatomata, and finally to demonstrate latent sepsis if present, which will at once manifest itself. As soon as possible after the first operation vigorous massage, manipulation, and kneading of the suspected area should be done through the dressings, and if latent sepsis is still present it will show itself and warn us not to proceed to the second stage. Otherwise in a week or two we can go ahead. However, there is sometimes no time limit of waiting, as secondary infection of hæmatogenous origin, as we may call it, may occur, notwithstanding the fact that the skin wound has healed by first intention.

COMMENT

Many methods have been employed to hasten and even to produce union in congenital pseudoarthrodeses, delayed union or non-union in bones, but the one that chiefly commends itself to consideration is one that furnishes tissue rich in osteophytes and other osteogenetic agencies or forces, such as the *osteoperiosteal graft* which obeys biological and physiological requirements *plus rigid and prolonged mechanical fixation,* as obtained by a bone-clamp, that will assure alignment and at the same time not interfere in the least with the blood circulation in bone or periosteum.

It is conceivable that we may secure this by means of both a combined Albee inlay and Delagénière osteoperiosteal graft, as one or separate elements. The latter needs no explanation, but the former may be obtained by lifting laterally an osteoperiosteal graft and then with the electric saw going through the whole thickness of the bone into the medulla to secure the inlay element, all in one piece.

CONCLUSION

As the osteoperiosteal graft is rich in bone-forming and infection-resisting elements it should be more widely used and more generally adopted by American surgeons in treating cases of non-union in fractures. It has found its place abroad, especially on the Continent and the usefulness of the method is demonstrated in my cases in which *secure fixation was afforded in addition to the osteoperiosteal graft.*

A study of the X-rays in these foreign cases strikes one as showing a sinuous or irregular outline in the new forming bone from unstable fixation. The author, therefore, urges that with the adoption of the *osteoperiosteal graft,* his technique and the *bone-clamping* to secure proper alignment in fragments and in the developing bone be used.

AMELIORATION OF LABOR PAINS BY MORPHINE–MAGNESIUM SULPHATE INJECTIONS AND COLONIC ETHER INSTILLATIONS

Directions for Administration by Method Evolved at the Lying-In Hospital of the City of New York

By ASA B. DAVIS, M.D., F.A.C.S., New York

IN January, 1923, the idea of ameliorating labor pains by a harmless, inexpensive method, which could be used by a physician without special training, in the home or hospital, and which would employ drugs in common use, was conceived by Dr. James T. Gwathmey, and successfully carried out at the Lying-in Hospital of the city of New York, with the co-operation of the attending surgeons, house surgeons, druggist, and head nurses of the hospital. The method which was adopted is described.

DRUGS NECESSARY

1. *Magnesium sulphate with morphine.* (a) Ampules containing 2 cubic centimeters of a sterile 50 per cent solution of magnesium sulphate (C.P.) together with a quarter of a grain of morphine sulphate.

(b) If the above ampule (a) cannot be obtained, a quarter of a grain tablet of morphine sulphate may be dissolved in boiled water and mixed with the contents of a 2 cubic centimeter ampule of a sterile 50 per cent solution of magnesium sulphate (C. P.).

2. *Magnesium sulphate.* Ampules containing 2 cubic centimeters of a sterile 50 per cent solution of magnesium sulphate (C. P.). Have at least 4 of these on hand for each case.

3. *Retention enema* (ether instillation):

Quinine hydrobromate	grains	20
Alcohol	drams	3
Ether	ounces	2½
Olive oil (good quality) up to	ounces	4

First mix the alcohol and the quinine, then add the ether and the olive oil. Stir the mixture and strain through cotton. Bottle and cork well. This may be kept at room temperature, and is undoubtedly stable for a month. If more than one ether instillation is given to the same patient, subsequent ones should contain only 10 grains of quinine. Therefore for each labor have on hand: Two bottles containing 20 grains of quinine (one for emergency in case part of the first instillation is expelled). Two bottles containing only 10 grains of quinine for subsequent instillations. Label all bottles carefully. For a large obstetrical service, it is not advisable to make up the retention enema in bulk, in amounts larger than 40 ounces, i.e., enough for ten instillations, as inaccuracy is almost unavoidable when larger amounts are made. Further inaccuracy can be avoided by immediately dividing the 40 ounces into ten instillations of 4 ounces each and placing in 10 bottles, instead of pouring 4 ounces, or one instillation, from the 40 ounce mixture when needed.

4. *Olive oil.* A bottle containing 2 ounces of olive oil.

In a large obstetrical service where economy must be considered, quinine (alkaloid) can then be used instead of quinine hydrobromate, since the former requires less alcohol to dissolve it. Heavy liquid petrolatum can be used instead of olive oil since the former is cheaper. The formula would then read:

Retention enema (ether instillation):

Quinine (alkaloid)	grains	20
Alcohol	minims	45
Ether	ounces	2½
Liquid petrolatum (heavy) up to	ounces	4

The directions for preparing, putting up in bulk, and administering the ether instillation with quinine (alkaloid) and heavy liquid petrolatum, are the same as for the first mentioned ether instillation, put up with quinine hydrobromate and olive oil. If the ether instillation is put up with heavy liquid petrolatum, we must have on hand an extra bottle containing 2 ounces of heavy liquid petrolatum in place of the bottle containing 2 ounces of olive oil. The directions for administering the liquid petrolatum are the same as when olive oil is used.

APPARATUS NECESSARY

1. *Glass syringe.* (a) If the 2 cubic centimeter ampule containing both the morphine and the magnesium sulphate is used, only a 2 cubic centimeter syringe is needed.

(b) If the morphine tablet is dissolved in the usual way in a teaspoon with some boiled water, more than 1 cubic centimeter of water is usually used, and this together with the 2 cubic centimeters of magnesium sulphate would require a 5 cubic centimeter syringe.

2. *Needle.* One that fits the syringe, the kind usually used for intramuscular injection, 1½ inches long, 19 gauge.

3. *Five ounce funnel* (glass or white enamel). *Twenty inches of rubber tubing* (size to fit funnel and glass connecting tip).

Rubber catheter. Size 20 or 22, French. Those made of red rubber, because as they are stiffer, they are better than those made of brown rubber. A rectal tube should not be used as it permits the fluid to run through too rapidly.

Glass connecting or irrigating tip (4 inches long). Attach one end of the rubber tubing to the funnel, connect the other end by means of the glass connecting tip to the catheter, leaving part of the glass exposed. This will be found more convenient than attaching the funnel to the catheter directly, and it also permits one to see, through the glass connecting tip, when the last of the fluid from the funnel has passed into the catheter.

4. *Artery clamp.* Used to clamp the catheter.

DIRECTIONS TO BE CARRIED OUT IN THE FOLLOWING SEQUENCE

1. *Enema.* When the patient goes into labor the usual soapsuds enema is given for emptying the lower bowel. This is essential for the instillation. If the morphine-magnesium sulphate is not given within 8 hours after the initial enema, repeat the latter just before administering the morphine-magnesium sulphate. The enema should not be given just before the instillation, but if this cannot be avoided, any water which may remain after the movement should be syphoned back with a rectal tube before the instillation.

2. *Morphine-magnesium sulphate injection.* (a) Time of administration. Not too early, but when labor is well under way, so that the morphine will not stop the uterine contractions altogether. At this time, when the contractions are strong and coming every 3 to 5 minutes and lasting 30 to 45 seconds, the patient complaining of the pain, it is well to make an examination (if the physician is with the patient) before giving the morphine-magnesium sulphate, though this is not necessary. It is best to have the cervix at least 2 fingers dilated. On the other hand, when the patient is first seen, if labor has already advanced considerably, i.e., the contractions strong, painful, and frequent, and delivery expected in less than 1½ hours, this injection may still be given. Even if the birth takes place in less than 1 hour after the injection no harm will come to the baby. Give the injection during an active pain, when the discomfort will be less noticed. Tell the patient that the object is to relieve pain, but do not promise her a painless labor.

(b) Method of administration. Cleanse the site of injection, and make sure the needle and syringe are sterile. The contents of a 2 cubic centimeter ampule containing both the one-quarter of a grain of morphine sulphate and 2 cubic centimeters of a 50 per cent magnesium sulphate are injected deeply, intramuscularly, into the gluteal region (not into the outer side of the thigh over the fascia lata), with a 2 cubic centimeter syringe. Avoid injections under the skin; hence never use needle shorter than the one advised. (Do not use ordinary hypodermic needle.) This method is to be preferred since it is the cleanest and least painful, because the smallest possible amount of fluid is used.

Morphine sulphate grains one-quarter is dissolved in the usual way in a teaspoon after water has boiled in the spoon. The morphine sulphate solution is drawn from the spoon into a 5 cubic centimeter syringe containing the 2 cubic centimeters of 50 per cent magnesium sulphate. The injection is then made as above.

Note that morphine sulphate does not dissolve readily in a 50 per cent magnesium sulphate solution. If the tablet is thrown into the barrel of the syringe containing the magnesium sulphate solution, considerable shaking is required to dissolve it. If the finger is held over the end of the syringe, while shaking, this method is far from clean and inadvisable.

3. *After the injection of morphine-magnesium sulphate.* (a) The patient should be kept quiet. Give only the necessary attention, put cotton in the ears, and so far as possible, avoid loud talking or noise of any kind. The environment must be such as to favor a natural falling asleep. If in a ward, screen the bed; if in a room, lower the shades and exclude the light, also close the door. The patient must be watched while asleep as she may turn from side to side during contractions and fall out of bed.

(b) One-half hour after the morphine-magnesium sulphate injection, give a second intramuscular injection consisting of 2 cubic centimeters of 50 per cent magnesium sulphate alone. This is given regardless of whether or not the effect of the first injection is sedative; this second injection tends to prolong the action of the morphine.

4. *Ether instillation.* If the physician is with the patient, it is well to make an examination before giving the instillation, though this is not necessary. It is best to have the cervix at least three fingers dilated.

(a) Time of administration. Not too early. If the effect of the morphine-magnesium sulphate is sedative, withhold the instillation until the effect of the morphine-magnesium sulphate is almost

worn off. It is easier to give when the patient is still under the influence of the latter, and more readily retained; however, strong, 3 to 5 minute contractions must be present. For the beginner it is better to let the morphine-magnesium sulphate wear off entirely, and to withhold the instillation until the patient is again complaining, and 3 to 5 minute contractions are good and strong. This is better than having labor retarded because the instillation has been given too soon. Patients, to whom the morphine-magnesium sulphate has been given toward the end of labor, often deliver before there is any indication for the ether instillation.

If there is no relief from the morphine-magnesium sulphate within 20 minutes after the second injection of 2 cubic centimeters of 50 per cent magnesium sulphate alone, give the ether instillation. The ether instillation should never be given sooner than 50 minutes after the first injection of morphine-magnesium sulphate.

(b) Method of administration. Warm to about body temperature the bottle containing the ether mixture, and also the bottle containing the 2 ounces of olive oil, by letting the bottles stand in warm water for a few minutes with the corks loosened or removed. Loosen or remove the corks lest they blow out and cause confusion and loss of part of the mixture.

Place the patient on her left side with the buttocks at the side of the bed, and apply vaseline liberally about the anus so that the ether, if expelled, will not burn. State to the patient, just before beginning the instillation, that its object is to relieve pain and thus secure her co-operation, but do not promise her painless labor. Tell her that during the administration she is not to press down during pains but to breathe deeply with her mouth open. This will prevent expelling the instillation; also have her at all times "draw up" with her sphincter as if she were trying to avoid expelling gas, as this will induce reverse peristalsis and permit the fluid to run in more readily.

Have an assistant hold the funnel as high as possible above the anus and pour into it one ounce of the warm olive oil. Just as the olive oil runs out of the catheter pinch the latter with an artery clamp near the glass connecting tip. In this way all the air is expelled from the tubing. Some of the 1 ounce of olive oil should remain in the funnel; this it will not do if too much is permitted to run out of the catheter.

With the clamp still in place, the person who is to give the instillation now inserts the catheter into the rectum for about 6 to 8 inches. If the fetal head is well down in the pelvis, as is common in primipara at the beginning of labor, the gloved finger must be inserted into the rectum with the catheter, in order to make sure that it passes the head, or else the fluid will not be retained. When the catheter has been inserted, it must be held constantly in place, so that it does not slip out and cause irritation to the rectum by being pushed in again.

A little of the warm ether mixture is added slowly to the olive oil in the funnel, the clamp is released, and the contents of the funnel permitted to run into the rectum. The remainder of the ether mixture is slowly added, at no time permitting the funnel to become entirely empty. Just as the last of the ether mixture is about to leave the funnel, add the remainder of the warm olive oil (1 ounce). It will take the interval between three to five contractions, before the entire amount of the fluid enters the rectum. When the patient has contractions, however hard she may try not to do so, she may bear down a little, and the fluid will return into the funnel. It is best, therefore, never to fill the funnel to the very top or it will run over and some of the mixture escape. If the patient bears down, permit some of the fluid to return into the funnel, as a little gas is then expelled. Then clamp the catheter so that all does not return into the funnel and urge her to "draw up" at this time. If you clamp the catheter immediately, at the moment she bears down, without letting any of the mixture return into the funnel, it is liable to be expelled alongside of the catheter. When the contraction ceases release the clamp and continue the instillation. Watch the anus, and if any of the retention enema is lost while the catheter is still in place, add a little more from the second bottle.

After all the ether mixture and olive oil is out of the funnel and the last of it has passed into the glass connecting tip, clamp the catheter to prevent air being drawn into the rectum. Now make pressure on the anus with a towel, leaving the pinched catheter in place for from 10 to 15 minutes then withdraw the catheter gently. Continue to make pressure over the anus during three or four contractions after the catheter is withdrawn.

5. *After the ether instillation has been completed.* (a) Immediately give a third intramuscular injection of 2 cubic centimeters of 50 per cent magnesium sulphate. This tends to prolong the action of the ether.

(b) The patient may now be on her back, or in whatever position is most comfortable for her. The same quiet is observed as after the morphine-magnesium sulphate injection. Do not make a

rectal or vaginal examination too soon after an instillation, or the instillation will be expelled; if possible wait at least one hour. Do not be misled (especially in multipara) by the quiet appearance of the patient into thinking that she is having very slight contractions or none at all. Though quiet, she may be having strong contractions and may be progressing rapidly, and therefore should be watched carefully at all times, just as though she were not under the influence of the analgesia. The intensity and duration of the contraction should be ascertained by means of abdominal palpation, the perineum should be watched for bulging, and the fetal heart should be counted.

(c) When the effect of the first ether instillation has worn off, i.e., the patient again complains of pain, a second, and even a third instillation may be given at intervals of 2½ hours or more. The first instillation is given with 20 grains of quinine hydrobromate; in subsequent instillations, use only 10 grains of quinine hydrobromate. Each subsequent instillation is accompanied with one intramuscular injection of 2 cubic centimeters of 50 per cent magnesium sulphate.

6. *Delivery.* Anæsthesia given by inhalation at the time of actual delivery should be ethylene, nitrous oxide gas, or ether, but not chloroform. If the patient is fairly well under the ether instillation at time of delivery, especially if a second instillation has been given, it is best to give no ether, or very little, by inhalation, at the time of delivery. If too much is given by inhalation, the baby at times is born slightly apnœic; nevertheless, this condition is transitory and respiration is always established.

7. *After delivery.* To ascertain how much relief has been obtained it is necessary to question the patient. We cannot judge by her actions during labor; at times, after administration of the drugs, the patient remains noisy and restless during uterine contractions; this would give the casual observer the impression that there was no amelioration of pain, and yet if such patients are questioned they often remark they remember little after the instillation, and admit that both the injections and instillations relieved the pains. Other patients become very quiet after the administration of the drugs, and yet on being questioned the next day, will state their pains were not much relieved. In either case they were benefited. All questioning should be done not earlier than 24 hours after delivery. Since the patient was not promised a painless labor, she should not be asked whether she had any pain; she should be questioned as to whether the injections or instillations, or both, relieved her pain, and to what extent.

SYNOPSIS OF PRECEDING DIRECTIONS

1. Give enema. If the morphine-magnesium sulphate injection is not given within 8 hours after the initial enema, repeat the latter just before giving the first injection.

2. When contractions are strong and coming every 3 to 5 minutes, the patient complaining of pain, it is well to make an examination, though this is not necessary. (It is best to have at least 2 fingers' dilatation.) Then give:

(a) ¼ grain morphine with 2 cubic centimeters of 50 per cent magnesium sulphate.

(b) ½ hour after first injection give 2 cubic centimeters of 50 per cent magnesium sulphate.

These injections may be given even if the delivery is expected in a short time.

3. Ether instillation. Before giving, it is well to make an examination, though this is not necessary. (It is best to have at least 3 fingers' dilatation.)

(a) If the morphine-magnesium sulphate injections produce no sedative effect within 20 minutes after the second injection, give instillation.

(b) If the morphine-magnesium sulphate injections produce sedative effect, withhold the instillation until the contractions are again strong and coming every 3 to 5 minutes, and the patient again complaining of pain. If the morphine-magnesium sulphate injections are given toward the end of labor, with sedative effect, delivery often takes place before there is any indication for the ether instillation.

(c) When the effect of the first ether instillation has worn off, and the patient again complains of pain, give a second, or even a third instillation. Subsequent instillations never to be given at less than a 2½ hour interval and always with only 10 grains of quinine.

4. Follow the initial and all subsequent ether instillations with 2 cubic centimeters of 50 per cent magnesium sulphate.

Important Precautions

Do not begin injections or instillations too early. Give injections during active pain. Give intramuscularly in gluteal region with long needle. Do not inject in outer side of thigh. Do not use ordinary hypodermic needle. The patient must be watched while asleep, as she may turn from side to side and fall out of bed.

Make every effort to have instillation retained:

a. By telling the patient how to co-operate. (Mouth open during pain, draw up with sphincter.)

b. By telling the patient she will get relief if the instillation is retained.

c. By preventing air from getting into the rectum, while giving the instillation.

d. By leaving clamped catheter in rectum for from 10 to 15 minutes after entire instillation is in rectum.

e. By making pressure over anus during three to four contractions after catheter has been removed.

f. By making no vaginal or rectal examination for at least one hour after the instillation.

At time of delivery give as little ether by inhalation as possible.

WHY THE ANALGESIA SHOULD BE GIVEN

1. Ninety per cent of the patients secure some relief, many a great deal. Poor results are often due to faulty administration and faulty modifications.

2. It can be used as easily in a home as in a hospital. In the Out-Patient Department of the Lying-In it has been given to over 300 patients by the House Staff.

3. It is inexpensive, especially when compared to gas oxygen analgesia given over a prolonged period during labor.

4. It requires no especially trained person to give the actual injection or the actual instillation; any trained nurse can give them. No special attention is required.

5. The physician does not have to be present at all times throughout the labor.

6. The drugs recommended by Gwathmey have all been safely tried out in other fields of medicine previous to their use at the Lying-In Hospital.

7. The use of the drugs prescribed by Gwathmey for over 2 years at the Lying-In Hospital in over 1500 labors, has proved that they are safe in obstetrics. If a cardiac case, or a toxæmia case, or a case of placenta prævia is permitted to go into labor, the use of the analgesia is not contra-indicated. No presentation or position is a contra-indication to its use.

Contra-indications. Colitis, true diabetes, and auditory disturbances, are the only contra-indications.

8. The patients are quieter during labor, undergo less strain, and therefore are in better general condition the day after labor is completed.

9. The ether instillation relaxes the perineum so that, if anything, the perineal stage is more rapid.

10. The *intramuscular* injections cause no subsequent painful induration of the muscle as do mercury injections. Abscesses occur no more frequently than with other hypodermic injections. In over six thousand injections only six abscesses developed, and in at least four instances, these could be traced to faulty technique.

11. By comparative statistics at the Lying-In Hospital, operative deliveries, asphyxia of the fetus during labor, stillbirths, and postpartum hæmorrhages, even if the delivery occurs within 1 hour after the morphine-magnesium sulphate injections, are not more frequent than if the method had not been used.

12. When the occiput is in the posterior position labors are usually longer than when the occiput is in the anterior position; the analgesia, however, does not prolong the labors still more in such cases.

13. There is no subsequent rectal irritation, only occasionally a slight burning sensation during the instillation.

14. Vomiting during labor is only a little more frequent than that observed in labors without the analgesia.

15. If it excites the patient she does not have to be forcibly held in bed, as was so frequently the case with twilight sleep.

16. Labors are rarely prolonged.

A. Just as when morphine alone is given for the purpose of softening a rigid cervix, and the contractions are sometimes stopped, so if the morphine-magnesium sulphate is given as directed, i.e., not too early, labor is also occasionally stopped. If the morphine-magnesium sulphate is given only when the delivery is expected in less than 1½ hours, it occasionally prolongs labor slightly.

B. The ether practically never stops the contractions when given at the time directed. In the second stage the patient bears down in the usual way.

Even if the drugs should prolong or stop the labor, no harm is done, and at any rate, the patient is not suffering.

A FEW VARIATIONS FROM STANDARD METHOD

The preceding directions should be explicitly followed in each case, without variations. Only after considerable experience should one individualize.

1. If for some reason (nervous patient, etc.), it is desired to give a sedative before the contractions become really strong and painful and it is felt that morphine, grains one-quarter, might stop the labor entirely, the analgesia may be started with morphine grains one-sixth, with 2 cubic centimeters of 50 per cent magnesium sulphate.

2. If the first morphine-magnesium sulphate injection stops the labor entirely, and good contractions, causing real pain, begin only 4 or 5 hours later, and an examination at that time reveals no more than two fingers' dilatation, instead of giving the routine ether instillation, the patient may be dealt with as if no injection had been given, i.e., begin the analgesia again with morphine-magnesium sulphate, etc.

3. When the patient is first seen, if labor has already advanced considerably, i.e., the contractions strong, painful, and frequent, and delivery is expected in less than 1½ hours, the morphine may be omitted, and the colonic ether instillation with the magnesium sulphate injection given at once. This may be used even if it is apparent that the baby will be born in 1 hour, as it will relieve the patient and will only occasionally retard the labor. It is, however, more difficult to give at this stage (i.e., to have the instillation retained by the patient) than when it is given earlier to a patient who has had the morphine-magnesium sulphate previously, and is still a little under its influence.

4. If the first ether instillation with 2 cubic centimeters of 50 per cent magnesium sulphate injection has no sedative effect, or even excites the patient, and the actual birth seems far off, a second injection of morphine, grains one-sixth with 2 cubic centimeters of 50 per cent magnesium sulphate may be given at once, i.e., before the second ether instillation is given.

5. If the first ether instillation with the 2 cubic centimeters of 50 per cent magnesium sulphate injection has no sedative effect in ½ hours, and the actual birth is anticipated within 2 hours, the second instillation may be given at once, instead of waiting the usual 2½ hours for the second instillation. If a second instillation is given immediately after the first, only one-half the amount is used, i.e., 5 grains of quinine hydrobromate, 1½ drams of alcohol, 1¼ ounces of ether, and olive oil up to 2 ounces.

PHYSIOLOGICAL ACTION OF THE DRUGS AS USED FOR AMELIORATION OF LABOR PAINS

Morphine relieves pain, softens the cervix, quiets the patient.

Ether relieves pain, softens the cervix, relaxes the perineum, and also helps to dissolve quinine (alkaloid) and quinine hydrobromate. When given by rectum, sensory paralysis occurs first, consciousness is only affected later.

Olive oil and liquid petrolatum permit slow and even evaporation of the ether at body temperature, prevent irritation of the rectum.

Quinine hydrobromate and quinine (alkaloid). Contrary to some authorities, we are convinced at the Lying-In that the hydrobromate and alkaloid are absorbed by the rectum, as evidenced by the difference in the intensity of the uterine contractions when they were omitted from the instillation, and by the fact that after the labor some patients complain of buzzing in the ears or slight deafness. Postpartum urine examinations in patients who retained the instillations show quinine.

Alcohol dissolves the quinine hydrobromate and the quinine (alkaloid).

Magnesium sulphate acts synergistically with ether in producing analgesia and anæsthesia, as stated by Meltzer, and also prolongs the action of the morphine as shown some years ago by Gwathmey. It causes paralysis without preceding excitation. The central nervous system, however, is affected before the peripheral nervous system; therefore, pain and consciousness are affected first, much larger doses being required for paralysis of the motor nerve endings. There is no fear of giving poisonous doses when used as suggested for the amelioration of labor pains. For a man weighing 165 pounds, 128 injections of 2 cubic centimeters of 50 per cent magnesium sulphate, given at one time, would be necessary to produce a fatal effect, and even then the only bad effect of the drug would be respiratory paralysis, which could be counteracted by the administration of any calcium salts, the latter reversing the action of the magnesium sulphate on respiration.

REGARDING THE PREVIOUS USE OF THESE DRUGS IN OTHER BRANCHES OF MEDICINE

Morphine has been given to relieve pain and quiet patients in other branches of medicine.

Ether in larger quantities than here used, has been given by rectum, with good results, to produce surgical anæsthesia.

Magnesium sulphate by injection without morphine, has been given in institutions for the insane, to produce sleep in patients, who, without it, would disturb others by their restlessness.

Morphine with magnesium sulphate, by intramuscular injection has been given in pre-operative surgical cases with good results at the Presbyterian Hospital in New York City. Dr. J. B. Branch, the professor of surgery at the Yale Medical School in China (personal communication), for over 3 years has used the combined drugs before operation, thus using less ether, and again after operation to avoid a second postoperative dose of morphine.

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SUPRACERVICAL (HIGH SUBTOTAL) HYSTERECTOMY, WITH CONSERVATION OF THE MENSTRUAL FUNCTION

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THE procedure advocated in this paper is one which I am sure is performed by all gynecologists at times. In some form or another it has been advocated by various writers of recent years (Spinelli, Beuttner, Bell, Polak, Culbertson). I am certain, however, that its importance is not sufficiently recognized and that many surgeons neglect to employ this technique in cases in which its use would confer great benefit to the patient. The question of conservation of menstrual function has revolved almost altogether about the ovarian function, and most surgeons have wisely accustomed themselves to conserving healthy ovaries whenever possible. Unless a portion of the endometrial surface is likewise conserved, however, the menstrual function is abolished. There are some who attach very little importance to this occurrence on the ground that the mere absence of the menstrual function is not detrimental to the patient's welfare.

From a life and death standpoint this is of course true, and it may be conceded that sooner or later most patients adapt themselves to the new order of life quite satisfactorily. In others, however, the psychological effect of destroying the menstrual function is great, and it is difficult to convince many patients that they have not been defeminized by such operations. Furthermore, even though the ovaries be conserved, the removal of the uterus, as Graves has emphasized, may in itself cause unpleasant symptoms which, while not usually as severe as those due to removal of the ovaries, are still sufficient to make the patient uncomfortable for a considerable time. There are other disadvantages of an artificial abolition of the menstrual function which I shall not elaborate upon, particularly as they have been so well presented in a recent paper by Dr. W. J. Mayo.

The practical point to emphasize is that in a large number of cases where hysterectomy is called for, the menstrual function can be conserved with no possible harm and probably great benefit to the patient, by the simple expedient of amputating the uterus at a higher level than is commonly done. In the ordinary operation the amputation is done at about the level of the internal os, and not infrequently even lower. Usually, however, it can be performed just as easily from one to several centimeters above the internal os, so that a considerable cuff of endometrium is thus retained. Menstruation is reasonably sure to be maintained in such cases,

although quantitatively it is, of course, very much lessened. Such patients commonly report that they menstruate quite regularly and often for just as long a time as formerly, but that the amount is very scanty. When only a small amount of endometrium is left there is apt to be only a slight staining or spotting, lasting over the usual duration of the flow. There is much evidence, morever, to indicate that the life of conserved ovaries is much prolonged by retention of a portion of the uterus.

It need scarcely be said that such an operation as we are discussing is to be considered only when further pregnancies are impossible. Otherwise it is ordinarily wiser to save the entire uterus. In many cases the uterus is in such a bad condition that its partial removal is preferable to the preservation of the reproductive capacity. Here, as in all other conservative surgery, each case presents its own individual problem, the chief factors to be considered being the age of the patient, the number of children she has had, the desire for more pregnancies, the social and economic status of the patient, the condition of the uterus, especially as regards adhesions to the rectum and other organs, etc.

It is also scarcely necessary to state that supracervical hysterectomy of the type we are now discussing is not indicated where removal of both ovaries has been necessary. In these cases menstruation will, of course, not be possible anyhow, and there is no reason why any of the endometrium should be conserved. As a matter of fact, a better technical result, especially from the standpoint of peritonealization, is possible with the usual hysterectomy of either the subtotal or total type, depending upon the indication.

The two best known operations aiming at partial removal of the fundus with conservation of menstruation are those of Beuttner and Bell. The latter states that it is practically always necessary to remove the ovaries with the fundus and tubes, and that the procedure must therefore be combined with ovarian transplantation. This, however, is not my experience. Practically always it is possible to leave at least one ovary *in situ*, and this, to my mind, is infinitely preferable to grafting the ovary in a distant location. Beuttner's method is a plastic one, which removes only the upper part of the fundus. It is a rather complicated procedure which, in the class of cases we are now discussing, offers no advantage over the simple plan herein advocated. After all, it is conservation which needs emphasis rather than any one special method of operation. The latter can be varied to suit the individual case.

The disadvantage of leaving a very large stump is the fact that the anterior bladder peritoneal flap cannot so readily be utilized for covering over the line of suture, without at times considerable traction and a possibility of postoperative bladder disturbance. Speaking generally, my own impression is that the risk of postoperative bladder irritability after hysterectomy is not nearly so great as some would have us believe, but it would seem greater if the bladder were made to ride over a bulky uterine stump.

A not infrequent indication for the supracervical type of hysterectomy is found in cases of uterine myoma, where myomectomy, for one reason or another, is either impossible or inadvisable. Instead of amputating through the cervix, it is often better to cut through the uterus sufficiently high above the internal os to leave from one to several centimeters of endometrium. Otherwise the technique may be virtually the same as after the usual subtotal hysterectomy, and the stump can be peritonealized with the greatest ease and smoothness.

A second and even more frequent indication for the operation is furnished by chronic pelvic inflammatory disease occurring in young women where preservation of the menstrual function seems desirable. With both myoma and inflammatory disease, it is obvious that only a certain proportion of cases are amenable to this form of operation. The varied indications of individual cases of inflammatory disease may call for any one of several other plans of treatment—supravaginal hysterectomy, total hysterectomy, salpingo-oophorectomy with preservation of the uterus, etc. The same thing is true as regards uterine myoma. But a definite indication for the conservative type of hysterectomy is encountered in many cases. It is difficult to state indications arbitrarily, but if one bears in mind the general principles outlined, the field for supracervical hysterectomy will be broadened more and more at the expense of the more radical procedures.

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EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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THE PITUITARY BODY

LITTLE by little new light is being thrown upon the pituitary body. We are acquiring a more intimate and exact knowledge of its anatomical relations. An analysis of clinical types has resulted in a reclassification of original major groups, more frequent resort to surgical attack has provided more abundant material for the study of the various pituitary lesions, perhaps a little more is known of the effects of glandular feeding, certainly there is a clearer conception of the methods of dealing with the different clinical and pathological types.

Of the recent contributions to the literature of the pituitary body, quite the most notable is the Bowman Lecture by de Schweinitz.[1] De Schweinitz reviews a number of important anatomical observations which were made with the help of Dr. J. Parsons Schaeffer[2] whose dissections of 125 bodies at the Baugh Institute of Anatomy of the Jefferson Medical College were utilized for this purpose.

These anatomical studies are of especial interest since they have revealed a number of inaccurate statements which at one time or another have appeared in textbooks and essays and without verification have been accepted by the innocent reader or student. Of particular interest are the observations on the position of the optic chiasma with relation to the pituitary body and diaphragma. In 96 per cent of the 125 bodies examined, the optic chiasma was located either wholly or partly over the diaphragma sellæ and underlying hypophysis. But only in 12 per cent of these instances was the entire chiasma found resting upon the diaphragma; in 79 per cent the greater part of the chiasma had the diaphragma-hypophyseal relation, while the lesser part projected *behind* the dorsum sellæ; and in 4 per cent the entire chiasma was behind the sella. These observations explain in part the very varied distortions of the fields we see in enlargements of the pituitary body. Contrary to the prevailing impression, a *typical* complete bitemporal hemianopsia is by no means a constant, or even the most common, field distortion, as in so-called *typical* manifestation it has been recorded only in about one-third of the cases of tumor of the hypophysis. The important point is that the changes which take place during a typical development of bitemporal hemianopsia are not individual types, but constitute stages of an advancing process, which, usually, but not always begins in the upper and outer quadrant of the field. Many variations from this type are encountered. In his material de Schweinitz found homonymous hemianopsia in 6 per cent of the cases.

Another interesting observation was the variation in the distance between the basal

[1] Tr. Ophth. Soc., U. K. 1923, xliii.

[2] The anatomical observations of Dr. J. Parsons Schaeffer, quoted in the Bowman Lecture, much elaborated, will appear as a separate contribution by Dr. Schaeffer in a forthcoming issue of the *Journal of Anatomy*.

surface of the optic chiasm and the overlying diaphragma and pituitary body, in some instances a mere cleft, in some a clear vertical of 10 millimeters. Thus the pituitary body would have to double in size before pressure was made on the overlying chiasm or optic nerves. Of great practical significance is the extreme variation in the structure of the diaphragma. It was found to vary from a dense, strong and, save for a very small foramen, complete roof over the hypophysis to a mere peripheral rim with a relatively huge infundibular foramen. The diaphragma may be more or less fenestrated or of compact structure. One can readily see how these variations may influence both the direction of growth of the pituitary lesion as well as the incidence of headache. These and other examples might be cited to emphasize the important application of these anatomical studies to the clinical expression of pituitary growths.

De Schweinitz' observations as to the mode of production of field defects in pituitary disorder will interest all students. He doubts whether the principle of pressure or traction accounts for all the field distortions, for instance the scotomata, and although he recognizes the uncertainties which exist, he endeavors to make out a case for toxic influences in this respect based upon the relationships of the subarachnoid space to the perivascular spaces of the pituitary structure. Anything which de Schweinitz has to say with regard to the diagnostic significance of the ocular manifestation of pituitary disease may be accepted as an authoritative statement and the reader is referred to this section of his address for further details.

His address should reach a wider audience than the neurologist, ophthalmologist, or the neurological surgeon. He has reviewed lesions of the pituitary body in their relation to pregnancy, to patients after oophorectomy, to certain infections and toxæmias. Altogether the address contains a wealth of information on pituitary disorders with a bibliography that is encyclopedic.

As to the treatment of pituitary disorders, the surgeon is primarily and now almost exclusively interested in the pressure phenomema, notably headache and impending blindness. Immediate recourse to operative interference is not justifiable in all instances. When vision is not threatened, glandular feeding and radiation should be considered. While in the records of the Neurosurgical Clinic of the University Hospital there is not a single instance of the beneficial effect of glandular therapy, seemingly authoritative reports have appeared in support of the favorable influence of the administration of pituitary and thyroid extracts. One case is recalled in which, after a course of thyroid feeding, the hemianopsia and other signs of pituitary disease disappeared. When the appearance of the optic nerve head does not indicate atrophy, even though there may be a complete bitemporal hemianopsia, X-ray therapy is justifiable in competent hands and under proper supervision. The work of Bèclere is well known and in our Neurosurgical Clinic we have had very definite and satisfactory results in two cases.

The outstanding problem that concerns the surgeon alone is the method of approach. Among those who have had the most frequent opportunities for observation and the widest experience there is a recognized difference of opinion; some vascillate between the transfrontal and transphenoidal approach, some resort exclusively to the transfrontal approach, others express preference at least in all primary intrapituitary lesions, for the transphenoidal route. Whatever theoretical advantages may be advanced for one or the other of these methods, for the time being the

issue should rest upon the immediate mortality and the end-result. The mortality of transfrontal operations is admittedly high and so far as one can judge from the reports, the end-results are no better than those which are obtained by the transnasal method.

In the Neurosurgical Clinic of the University Hospital, *where in all primary intrasellar lesions the transphenoidal approach is practiced exclusively*, the mortality, once 5 per cent, is gradually being lowered. In fact there has been but one fatality in the past 4 years. With increasing experience in what was once an unfamiliar field, the apprehension with which we approached this operation is gradually being dispelled. The specially constructed bivalve speculum gives a perfect illumination of the field and with the aid of a suction apparatus the field is kept constantly unobscured by blood. With these two instruments the difficulties of the operation have been minimized to an extraordinary degree.

As to the effect of the operation in restoring vision, the results have been satisfactory in 70 per cent. When one takes into consideration the fact that in many instances degeneration of the optic pathways is already established, these results are as good as one might expect. Not until operative relief is sought in an earlier period can better results be anticipated.

CHARLES H. FRAZIER.

IRRADIATION TREATMENT OF MYOPATHIC HÆMORRHAGE

WHEN men of equal standing and ability become ardent disputants on any subject in medicine, a final decision frequently favors an intermediary policy. In the earlier history of the surgical treatment of myoma uteri, the mortality attending all operations was appallingly high when compared with modern evolutionized operations. Three decades ago, the electric treatment of these growths largely fostered by French specialists, appeared for the moment, because of its small risks, to challenge the right of surgeons to pursue an operative policy. Experience, however, gradually eliminated electricity as a reliable therapeutic agent because the development of hysteromyomectomy and myomectomy followed such secure lines that both morbidity and mortality sank to an exceedingly low point and through the beneficent effects of these operations the patient was assured of health and the fear of a recurrence was practically eliminated. Therefore, the skilled chirurgical craftsman of recent years has approached these problems with the greatest assurance of a successful issue. Myomectomy in young women yields excellent results, and when this is not feasible the removal of the uterus with conservation of the ovaries reduces climacteric morbidity to a minimum. With the attainment of such an exceedingly favorable trial balance, how could the results be bettered? To the positive mind of strict surgical trend there could be but one answer, consequently the discussion before such men of the merits of any form of irradiation in preference to an operation kindled as glowing a response as that of an oxyhydrogen blowpipe to a fading ember.

In testing therapeutic remedies of former days, decades or a generation might pass before the truth of an issue became clarified. Today, however, the well-ordered American clinics, with their follow-up systems, and the great medical societies of this country, which serve as progressive forums of debate, make it possible to arrive at a much more expeditious judgment. These institutions, therefore, function as great medical clearing houses in estimating the value of novel operations and therapeutic procedures. Thus within a decade one may with great confidence evaluate the

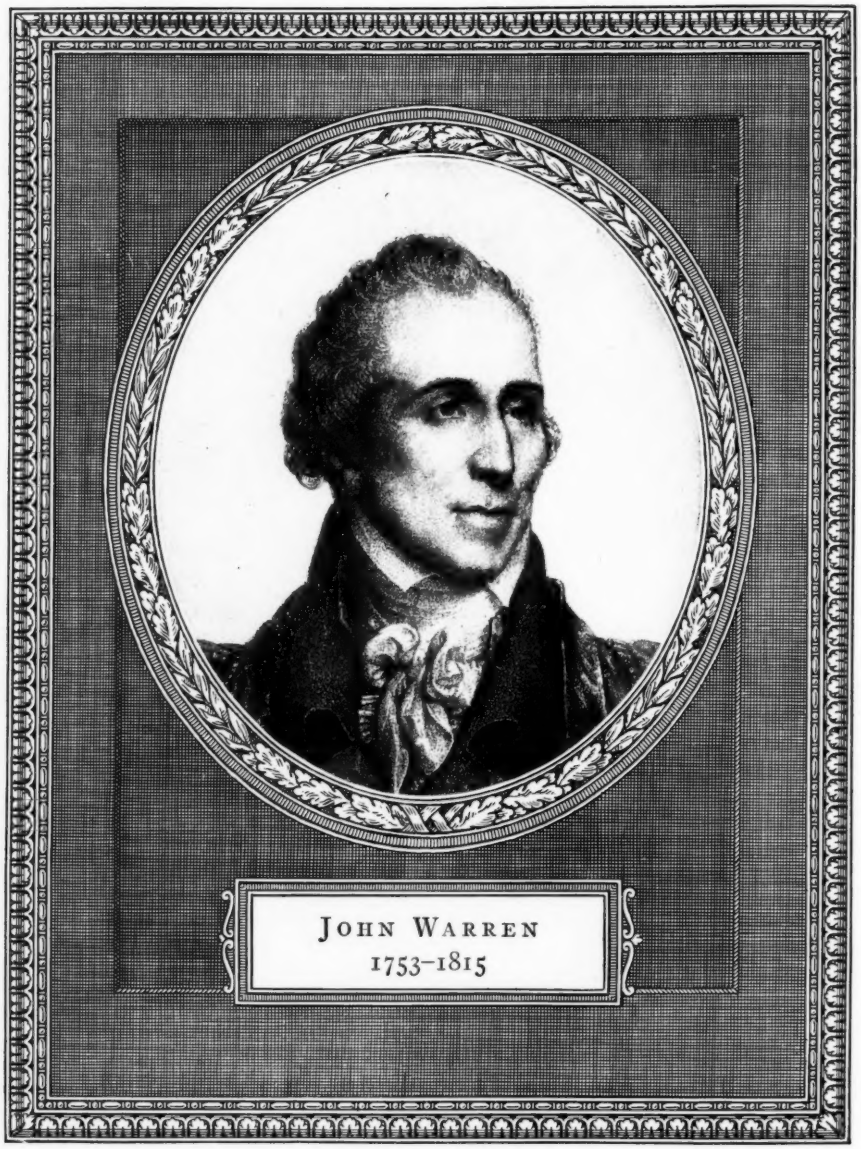
results of irradiation in the treatment of myomatous and myopathic transformations in the uterus. From this survey, one may assert that such a controversial phrase as "surgery versus irradiation" should be eliminated from current medical literature. Were such the issue the conclusion would be incontrovertibly in favor of surgery. As to a choice between these methods of treatment, surgical intervention would decidedly hold the vantage point, for its merits have been established beyond cavil. Irradiation in the light of our present knowledge must without question be subordinated to operative measures, and the judge as to its invocation should be the surgeon. Because of the dovetailing of these two therapeutic agents every gynecological and surgical clinic should have radium as a part of its armamentarium.

The application of this remedy should be made by the surgeons because its employment is attended by definite surgical risks. On the other hand, roentgen-ray treatment should be supervised directly by the roentgenologist, for its dangers can be estimated and avoided only by the specialist trained in this novel branch of physics. Neither remedy should be in the hands of the novice, for each is attended by great hazards if injudiciously employed.

While the value of irradiation has been established, it yields its best therapeutic results only to the careful diagnostician who takes into account the size and character of the tumor, its symptomatology, the age and nervous stability of the patient, and the associated or coincident pathological lesions. In the gynecologic clinic of the University of Pennsylvania we have for some time rested our decision as to the irradiation of these tumors upon one chief point, and that is hæmorrhage. Furthermore, experience has confirmed another rule, and that is to submit all tumors over the size of a four months pregnant uterus to operation unless there are such grave contra-indications as to render surgical intervention a too hazardous policy. Tumors which have as their chief symptomatic manifestation, pressure effects, should fall within the surgical domain, whereas in those uncomplicated tumors of a size under that of a four months pregnant uterus, whose sole symptom is excessive bleeding, irradiation is the method of treatment *par excellence* provided the patient is beyond her fourth decade, and that the tumor is not of the large submucous type. Myomata in young women fall, as a rule, within the surgical domain, as a myomectomy or partical hysterectomy, with preservation of the ovarian function, is decidedly preferable to irradiation. A point relative to the irradiation menopause: At one time we held as a blanket rule that the nearer the meridian of life the menopause was induced by any artificial means, the less the climacteric disturbances. As a result of comparative reviews of a series of myomata and pelvic inflammatory cases passing through the Gynecologic Service of the University Hospital, in which a surgical or an irradiation climacterium has been induced, it has been found that in general the age factor is still of capital importance in estimating the severity of this precipitate issue. However, another weighty factor, and one always to be estimated most carefully, is the nervous stability of the patient. A woman of equitable temperament at thirty years of age may be shaken relatively little by the abrogation of the ovarian function, whereas a nervous, apprehensive, neurotic woman in the fourth decade, will pass through a veritable climacteric upheaval if nature is forestalled in this event, just as she may when its natural termination arrives. In a nervous woman, therefore, the extirpation of the tumor with the conservation of ovarian

tissue even in the menopausal years must take precedence over irradiation. The fear of malignant transformation in myoma uteri has been greatly overstressed in the past as is shown by a critical pathological analysis of 816 myomatous tumors, which have passed through the Gynecologic Laboratory of the Hospital of the University of Pennsylvania. In this large number of cases only 25 sarcomata were discovered, and of these 12 could in no sense be considered as malignant transformations, but were sarcomata from the start and were so diagnosed clinically. In more than 1,300 hysterectomies, sarcoma subsequently developed in the cervical stump in only one case and this sequel was cured by two applications of radium. The infrequency of this type of malignant change and its dangers is therefore of negligible import as an urgent indication for surgical intervention.

Since cancer of the fundus can practically always be determined by a study of curettage débris, there is again very little possibility of error if the diagnosis rests upon skilled microscopic judgment. If well established rules are followed in selecting the type of case to be submitted to surgery and to irradiation the two methods of treatment will work in perfect harmony, and are in no sense antagonistic to each other. JOHN G. CLARK.



JOHN WARREN
1753–1815

MASTER SURGEONS OF AMERICA

JOHN WARREN

JOHN WARREN, surgeon of the Revolution, organizer, orator, practitioner of Boston until after the War of 1812, is to be credited with founding the Harvard Medical School, where he lectured in surgery for over 30 years. He was one of the chief founders and for 11 years was president of the Massachusetts Medical Society. He was one of the first to do an amputation at the shoulder joint, not to mention being an advocate of healing by first intention, in the days when the presence of "laudable pus" was thought to be a part of the normal process of repair in all wounds.

Of medium stature, well formed and of a military bearing, he had a most prepossessing appearance. Peale's portrait shows him with a high forehead surmounted by bushy hair, dark eyes, an acquiline nose, and an expression indicative of a genial nature which had not been hardened by the stern requirements of surgery in the pre-anæsthetic era.

Dr. Warren's father, Joseph Warren, was a farmer of Roxbury, now a part of Boston, a descendant of John Warren who came fellow passenger with Governor Winthrop in the *Arabella*, arriving in Salem on June 12, 1630. His mother, Mary Warren, was a daughter of Dr. Samuel Stevens, also of Roxbury. The father was killed by a fall from an apple tree in 1755 when John was 2 years old, for he was born on July 27, 1753. His brother Joseph and he were more or less dependent on their own exertions for their education. John, after taking his A.B. at Harvard in 1771, studied medicine in Boston for 2 years according to the custom of the time, with his brother Joseph, who was 12 years his senior, and then settled in practice in Salem where there was a less crowded field than in the capital. In college Warren, though not a deep student, became a good classical scholar and developed a love of anatomy, helping to form a club for the study of that subject, which at that time was given little attention.

Though absorbed in an active practice he was said to have taken part in the "Tea Party" in Boston Harbor, December 18, 1773. He joined Colonel Pickering's Salem regiment of militia as a private. Toward the close of the battle of Lexington, April 19, 1775, he arrived at Winter Hill, Somerville, with his regiment, but not in time to be in the engagement. After the battle of Bunker Hill, 2 months later, he left Salem at 2 o'clock in the morning in an attempt to learn

the accuracy of the rumor that his brother Joseph had been killed. While searching, he received a thrust from the bayonet of a British sentinel, the scar of which he bore through life. He volunteered at once as a private in the Continental Army and was assigned to the care of the wounded. He passed an examination before a medical board and received the appointment of senior surgeon to the hospital established at Cambridge, remaining on duty during the siege of Boston. With the transfer of the army to New York, the general hospital was moved to Long Island and Warren went there, May 11, 1776; then followed service in New Jersey and a narrow escape from capture following the battle of Trenton. He had a severe illness, applied for permission to return to Boston and was transferred to the General Hospital in the West End, in July, 1777, with the rank of senior surgeon, a position he filled until the close of the war. Then he settled in Boston as a practitioner.

The year 1780 saw a beginning of the Boston Medical Society. This organization which was made up of a group of the young physicians of the town, among whom Warren was a leading spirit, took an active part in promoting sound medical policies, made a fee table, and later mapped out a code of ethics. It was in this society that plans originated for a state medical society and for a medical school connected with Harvard. The club met at the Green Dragon Tavern and many a lively evening was spent in discussing ways and means. In the same year the American Academy of Arts and Sciences began its long career. To this society Dr. Warren, who became a member in August, 1781, contributed a paper in 1785 on a "Large Tumor of the Abdomen, Containing Hair." It was a case of dermoid cyst of the ovary which was opened by a median incision evacuating: "watery matter, pus, and a large quantity of short hair." The patient, one of the first upon whom an ovariotomy was done, made a good recovery, and the case excited much interest in the profession.

The Massachusetts Humane Society, an organization for assisting those apparently drowned and preventing drowning, came into existence in the year 1785. The first meeting of the trustees was held at Warren's house; he was the second president and a constant supporter of the society, which is in active operation today, as is the Society of Arts and Sciences. Dr. Warren's connection with the Massachusetts Medical Society is of considerable interest. He was a member of the Boston Medical Society when that organization was formed in 1780, before he was 27 years old. He seems to have been the energizing agent leading to the formation of the state society. His name appears among the fourteen petitioners for a charter in the bill filed in the Massachusetts House of Representatives in May, 1781; he was a constant attendant at the meetings of the society, was on many important committees, served as censor, councilor, corresponding secretary, vice president, gave the annual oration in 1805, and filled the presidential chair from 1804 until his death, the longest term of office

of any president, and at a time when the recently reorganized society needed a strong hand to guide it on its new path.

In the winter of 1780, Warren undertook to give a course of lectures on anatomy at the military hospital in Boston. His audience was composed of persons attached to the army in a medical capacity, a few medical students and some physicians of Boston, not a large gathering but one intensely interested in the practical dissections on the cadaver that had to be carried on with great secrecy on account of popular prejudice. The lectures were so much of a success that he was asked to repeat them. This he did, the course being attended by many literary and scientific men, including President Willard and members of the Harvard corporation, as well as by students from the college. A third course was given in Boston. It was in the winter of 1781, just after the first meeting of the state medical society, that Warren performed with success at the military hospital the operation of amputation at the shoulder joint.

Dr. Warren married in 1777 Miss Abigail Collins, daughter of John Collins, afterward Governor of Rhode Island. He had met her while she was visiting Colonel Mifflin's family in Cambridge. They had a happy married life of 37 years that was blessed by the birth of seventeen children. The eldest, the eminent John Collins, born in 1778, did the first operation under ether anæsthesia; and the youngest, Edward, born in 1804 was his father's biographer. Dr. Warren kept in close touch with his children; the letters he wrote to John Collins when John was a student of medicine at Edinburgh show strong affection, a broad outlook, and are delightful reading today.

As recording some of the many activities of this pioneer surgeon and organizer it is to be noted that in 1778 he formed a partnership with Isaac Rand and Lemuel Hayward to make a hospital at Sewall's Point, Brookline, for the inoculation for smallpox and the treatment of patients attacked by that dread disease. He volunteered as a private in the Rhode Island Campaign, returning to his hospital duties and to his family at its conclusion. The Corporation of Harvard College, impressed by Warren's efforts at teaching, voted in November, 1782, to establish a medical school with three professorships, on lines laid down by him. Warren was appointed to fill the chair of anatomy and surgery. His first lectures were given in Cambridge during the winter of 1783. He had a well modulated voice, an impressive manner, seldom used notes and held the attention of his students for periods as long as 2 hours. To reach Cambridge from his home in Boston was a long and tiring journey. It was not until 1810 that the school was moved to Boston and then the professor of anatomy and surgery had the assistance of his eldest son, who, at his request, had been made adjunct professor in 1809, thus lightening the teaching labors of a busy practitioner, for Warren was much in demand and surgery occupied a good deal of his attention. He was cool and deliberate in operating and did not omit details; although impulsive by nature

he held himself in control during the trying ordeals of operations on patients writhing with pain when there was no anæsthesia—difficult undertakings for a man with Warren's sensitive nature. John Collins Warren said that his father was a better surgeon than he. He praised the cataract operation his father did. Trained by an extensive practical experience in the army John Warren could afford to forego the study in European capitals that some of his contemporaries enjoyed and that he gave his son. At the time when the medical school had been started auspiciously Harvard conferred on him the honorary M.D. (1786), the only medical degree he held.

It was the custom in the period following the Revolution for practitioners of medicine to visit their patients on horseback, resorting to the use of a chaise only for long journeys. Dr. Warren observed the custom but rode and drove a bit recklessly, if we may believe his contemporaries. We may picture him dressed in the costume of the time, according to the biographical notes of his medical son: a colored coat, metal buttons, usually yellow; colored and figured waistcoat; short breeches, buttoning at the knees; long boots, with white tops and, when riding on horseback, a pair of leather breeches; a shirt, ruffled at the breast and about the wrists; a white cravat, filled in with what was called a pudding, and a cocked hat. After the year 1785 he lived in a large house on the north side of School street with stables, greenhouse, and outbuildings reaching as far as Washington street. In an office in a separate building students assisted with dressings and in the preparation and dispensing of medicines. The well furnished and ample mansion was a home and a place of entertainment for the important men and women of the time. His garden and fruit trees were a great interest and later, when he owned a small farm in Jamaica Plain, a near-by suburb, he was president of the Massachusetts Agricultural Society.

Dr. Warren's service as a practitioner brought him into contact with the extensive epidemics which prevailed in those days. He took a prominent part in the management of the yellow fever which visited Boston in 1798, and wrote a report on it. In 1808 he was one of a committee of the Massachusetts Medical Society to present a report of 50 pages on the smallpox that had broken out at Marblehead in 1801, the report being published in four newspapers of the town. His noteworthy contribution to medical literature was the annual oration before the Massachusetts Medical Society in 1805 entitled: "A View of the Mercurial Practice in Febrile Diseases," republished as a separate pamphlet of 187 pages in 1813, in which he advocated the use of mercury in many of the prevailing diseases of the period. Beyond an occasional contribution to the meetings of the state society and to the columns of the *New England Journal of Medicine and Surgery* he left few medical writings.

Space permits only a bare mention here of Warren's extramedical activities. He was chosen Grand Master of the Massachusetts Lodge of Free Masons in

1782; he delivered the first Fourth of July oration in the Brattle Street church in 1783, this taking the place of the Fifth of March oration commemorative of the Boston Massacre. He was a member of the Massachusetts convention for ratifying the federal constitution in 1788, and he addressed the voters in Faneuil Hall in the same year in favor of a memorial to Congress asking that the treaty with Great Britain might be put into effect. In 1796 he delivered a eulogy of the Hon. Thomas Russell, a distinguished merchant of Boston. Although Warren took a practical interest in the affairs of the nation, as well as of the community in which he lived, the rules of his professorship in the medical school forbade his holding public office had his inclination turned that way or had his medical duties permitted.

The termination of the War of 1812 had been celebrated on Washington's Birthday in 1815 by a procession and, in the evening, by fireworks and by an illumination of the entire front of the statehouse, for the first time. Dr. Warren, who had been in failing health with angina, went through the streets to see the sights with his youngest son, then 11 years old. On going home he said to him: "Now let me depart in peace, for I have seen the salvation of my country." Next month he had a letter from his brother in Foxborough, 25 miles away, that he had dislocated his shoulder. Warren drove to him at once, made several attempts to reduce the dislocation; was up nearly all night, finally succeeded and returned to Boston to make his usual rounds to his patients. Not long after he had an attack of pneumonia and died, April 4, 1815, at the age of 61, leaving his widow and nine children. An autopsy showed extensive disease of the arch of the aorta and pleuritic adhesions of long standing. Mrs. Warren survived him until 1832, when she died at the age of seventy-three.

WALTER L. BURRAGE.

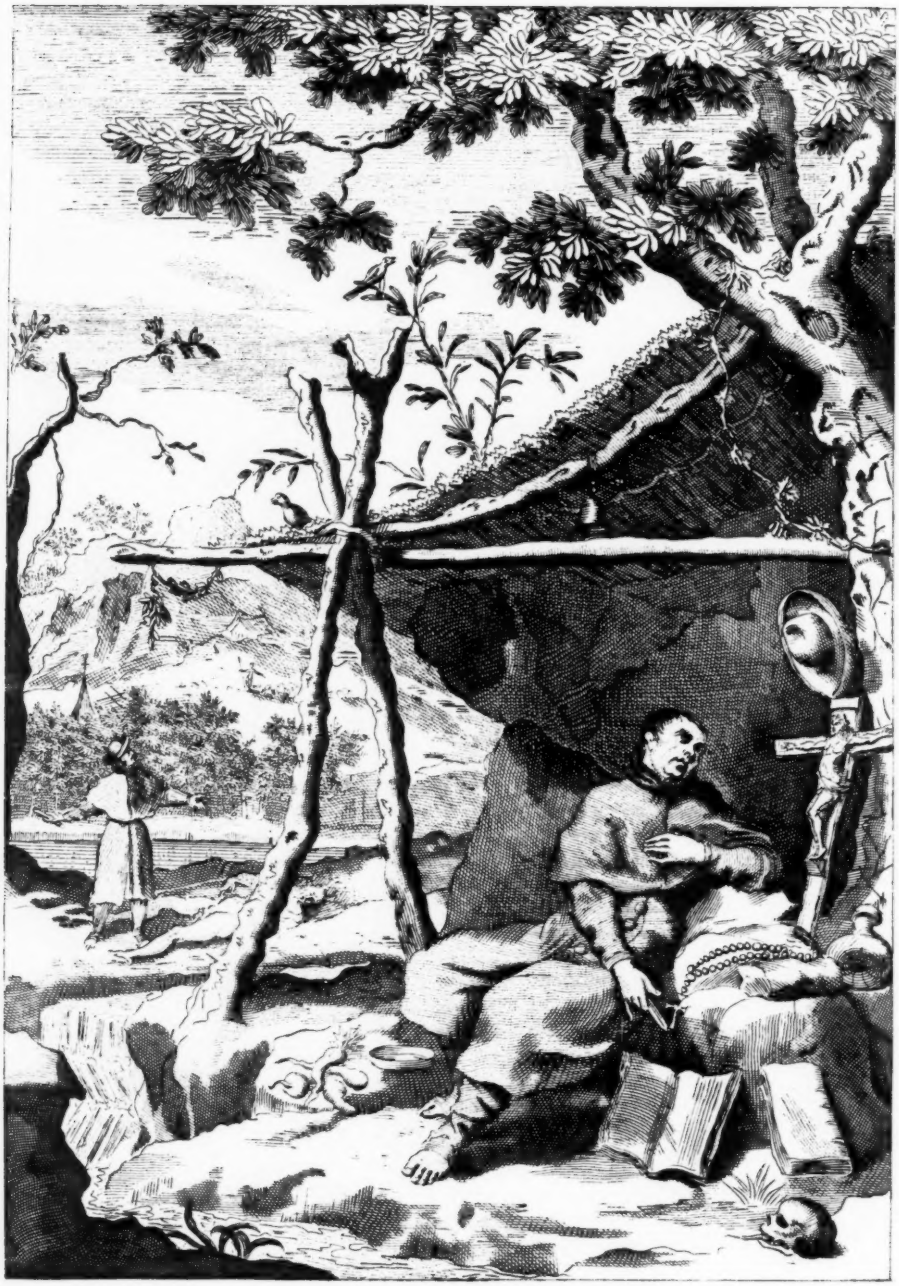
THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY—LITHOTOMY AND THE LITHOTOMISTS

By ALFRED J. BROWN, M.D., F.A.C.S., Omaha, Nebraska

THE story of lithotomy is perhaps one of the most interesting of any surgical procedure. Leading us back as far as records go, we find it mentioned as practiced among the early Egyptians, opening up to us a study of their civilization. From that point as a beginning, the path of curiosity if one cares to call it such, or historical research if it soothes the vanity better, leads us down through the course of the ages amid all the various schools of different peoples, and by observing as we pass, we get an insight into their method, action, and thought. We walk with Hippocrates and learn from him his contempt for those who practiced lithotomy and his sorrow that medical men were looked on as one of the lowest classes of the people. Still he did not see that in belittling the lithotomists he was helping to form that low opinion in the lay mind. Leaving Hippocrates we continue with the physicians of Greece and Rome, and then the Alexandrians and Arabians, those men of science who left a record of their constant endeavor to discover new things in medicine and surgery. From them we pass to the middle ages. At first there is a reversion to ancient teachings without much independent thought, but as we go on the independent thought creeps in, and physicians no longer are content to take the word of their forbears as law, but branch out and think and act for themselves. New facts are found in medicine and new modes of practice spring into being. As we go on we find ourselves among the crafts and gildsmen. For the old opinions are so strong that the well educated physician, being of the elect, and of the philosophers, will not stoop to work with his hands, and so leaves that to others, some of whom work with him but many cut the leash and go by themselves, practicing as independents. We now find many ramifications of our path and perforce, led by that curiosity of ours, go up a byway, here for a way and another there, leading us among the gildsmen on this one and on another we walk with Samuel Pepys and hear of his experiences with his recurrence of the stone and how this one and that one were laboring under it. We go with him to his box maker and help him design his case to carry his stone in so he can show it better and see him pay his 24 shillings for it. We meet John Evelyn and go with him and Pepys to see his brother Richard so that Sam can show his stone "as big as a tennis ball" to Richard in order to "encourage his resolution to go through the operation." Later Pepys invites us to foregather with him and his friends at one of his annual parties on the first of May when the members of the elect who have been cut for the stone meet to celebrate, with wine and song, their deliverance from the dread malady. We see the stones, handed around in their specially made cases and listen to arguments as to which was the larger and more difficult to remove. The reasons why each was the sickest man that ever recovered and that his was the most difficult case his surgeon ever had. Finally we leave Pepys and his friends, carrying with us a sheaf of those beautiful cards which the English and French dandies had made, with a picture of the stone and the date of their deliverance with any other minor facts that they chose to mention. In France we follow the path with those who are doing the operation. Specialists all in their line, not of the regular medical profession, but evolving new methods and constantly bettering their work. We walk with the Collots, fathers and sons, practicing lithotomy for a hundred years, recom-

PHILIPPES COLLOT



mended by Ambroise Paré in his time and friends of the greatest surgeons. We see Frère Jacques and spend a time with him in his hermitage and watch him do his new lateral lithotomy. Finally the path broadens. We meet and walk with the regular profession, for the proper place of lithotomy has been recognized and it becomes an operation no longer despised and one to be turned over to a craftsman, but one to be practiced by the educated surgeon.

FRATER JACOBUS DE BEAULIEU

Lithotomy being a necessity, has lived, but not because of the effort of those who practiced it. For many years it was a craft, practiced by semi-ignorant men and charlatans, looked looked down upon by the educated members of the profession and turned over by them to these men who formed what might be termed a gild, though never organized beyond the general medical gilds. Their methods were secret and handed down by word of mouth and practical precept from generation to generation. As a result the lithotomists flourished through the centuries and preserved their methods and their skill, and rather in spite of their desires and intentions their art has weathered the storms of time. The methods of some of the gilds have not fared so well and are today included among the lost arts and have been lost because of the origin of other methods. For example, in the fifteenth century, Gutenberg invented the movable type and printed his bible. The art of printing came into general use a few years later. Much as printing has done for mankind, at the same time we must regret that as a result, limning has perished and no one has ever been persistent enough to rediscover it. Though we have our beautifully printed books of the last few centuries and though color printing as done at present is undeniably artistic, still when one looks at a beautiful Book of Hours, done on vellum with its painted miniatures the colors of which are as fresh today as when put on and in places sparkling with the wonderfully overlaid gold, one heaves a sigh of regret that the art of the limner has passed into oblivion and is gone.

Medicine and surgery in general of the time preceding the Christian era as well as during the early part of this era was without doubt looked upon as a disreputable profession. The so-called high class physician was either a cleric or a savant and did not demean himself by performing any class of manual labor. This left all surgery to be done by ignorant and poorly educated men who gained their knowledge as they could and practiced with all the charms and amulets and incantations they could muster to fool an unintelligent and trusting public. Another influence affecting lithotomy and also obstetrics was the fact that the knowledge concerning generation was practically nil. Consequently the genitalia were taboo (even more so than during the mid-Victorian era when polite society spoke of a bull as a cow) so, save only the Hebrew cleric, any one who demeaned himself by operating on the genitalia was beneath contempt. Hence charlatanism and secrecy of method flourished. In obstetrics midwives performed the delivery, occasionally under supervision, but in lithotomy the untrained surgeon flourished with no check or hindrance until the 19th century.

With all the drawbacks the technique of the operation improved gradually during the period of development and the lithotomist evidently attained great skill and dexterity. As to their diagnostic ability one can have doubts, for the number of operations performed was much greater than it is today. One wonders whether other causes of urinary obstruction such as stricture and enlarged prostate were not operated upon under the name of stone and account for some at least of the incurable fistulæ that all the writers mention and fear so much.

The technique of the operation is described in *The Ramayana* an Indian work thought to have been published about 250 B. C. In men the operation was through the abdominal wall. The surgeon introduced his fingers into the rectum and pushed the stone up against the abdominal wall and held it there while making his incision through the wall and bladder. Then, by continued pressure the stone was evacuated. The surgeon is warned against leaving any pieces of stone or small stones behind for fear of forming new ones so there must have been some method in use for breaking the stone. In women stones were removed through an incision in the anterior vaginal wall continued through the neck of the bladder. Hippocrates neither performed nor taught lithotomy. In fact he advises against it in the oath which his students took for he says: "I will not cut persons laboring under the stone, but will leave this to be done by men who are practi-

tioners of this work." The method of breaking a stone in the bladder was evidently known to the Alexandrian School. In Celsus is found the description of a method which consists in passing a hooked instrument behind the stone to hold it firmly in place. The stone is then broken by a blunt pointed instrument held against it upon which the operator pounds. The method of Celsus, slightly changed by Paulus, persisted for many years and was recognized as the standard to be used. The instruments used to deliver the stone were hooks and spoons. The forceps was introduced at a later date but just when is not definitely established. Albucasis warns against performing the operation on any but young people for fear of death or persistent fistula. Brunus describes the lithotomy position, though he does not name lithotomy, when he describes the method of pushing an impacted stone out of the neck of the bladder with the finger or a catheter in patients too old for lithotomy for he advises tying the legs to the neck with a long bandage. In the works of nearly all the older writers, methods of treating or removing the stone are found. Lanfrancus goes so far as to advise suture of the wound after operation. Many writers speak of removal of clots with the finger after the removal of the stone. Perineal lithotomy was in use as described by Rufus, and the danger of sterility following this operation because of cutting of the "vasa spermatica," was noted. The operation was further simplified by the appearance of two instruments. The so-called itinerarium which was a sound to locate the proper place to make the incision and the forceps with which to withdraw the stone or to hold it while it was being broken by chisel and hammer.

Benedetti described median perineal lithotomy through the neck of the bladder. Dalla Croce describes the operation of Celsus and adds the technique of holding the stone with forceps while it is broken with chisel and hammer. Franco describes the two-stage operation to be used in old and weakened patients. The incision is to be made first and the stone removed the following day. He also stretches the wound with a gorget to remove the stone. The instruments advocated and employed by the various surgeons differed slightly but are basically the same. They may be found illustrated in most of their works.

The sixteenth century saw the rise of the famous Colot or Collot family of lithotomists. The first of the line, Laurent, was a friend of Ambroise Paré and from him received a large amount of practice. He learned the operative technique from Ottaviano da Villa who in turn had been a pupil of the famous Mariano Santo di Barletta; famous because in 1531 he published the description of the so-called "Apparatus Magnus or Major" the then perfected method of lithotomy, which also passed under the name of Mariano's cutting for the stone. It has been shown that Mariano was not the originator of the method but learned it from Giovanni de Romani of Cremona who in turn probably obtained his knowledge of it from Battista di Rapallo, the father of Giovanni de Vigo. Laurent Colot's sons, Laurent and Jean, both practiced lithotomy. Another famous Colot was Philippe (1593–1656), the father of Francois (1630–1706), the last of the line who left a record of his work which was published posthumously at Paris in 1727.

One of the most picturesque figures in the history of lithotomy was the hermit monk, Frère Jacques de Beaulieu (1651–1714). Originally a common laborer and later a soldier, he gradually learned something of medicine and finally became a lithotomist of great reputation. Later in life Jacques Baulot joined the Franciscans and became Frère Jacques, the anchorite and hermit and added to his natural skill the necessary personality to make him famous over all of Europe. Frère Jacques practiced both suprapubic and perineal lithotomy as one of the illustrations reproduced here shows but was apparently partial to the perineal method as he passes as the inventor of the operation of lateral lithotomy. Aside from his portraits and mention of him by others there remains no written record and it is doubtful from his history if he was able to write a record of his observations. His work was apparently good and his record, what there is of it, remains as that of one of the greatest of what may be called the famous journeymen lithotomists.

REVIEWS OF NEW BOOKS IN SURGERY

HERE is a book which it behooves every medical man to read, be he undergraduate or licensed physician, gynecologist or country practitioner—a history of Medicine.[1] Besieged as we are at present by incessant demands to cut down medical education to so-called essentials, meaning in effect the treatment of this, that, or the other ailment, to shorten the years of study, to reduce cultural entrance requirements, in brief, to omit from the curriculum anything that might raise the practice of medicine above the level of a craft or trade—amid all this discussion it is refreshing to know that there still are men who can devote time and effort to write a book such as this which is not meant to serve an *immediately* utilitarian purpose. Yet, medical educators are unanimous in the opinion that a knowledge of the history of medicine widens the horizon, broadens the outlook upon many medical problems, in short, makes for a more complete and, therefore, better doctor. What better example could be adduced than our own William Osler, that great physician and lover of medical history. Osler, I think, would have liked this little book which, in an admirably concise manner, unrolls before the reader the entire evolution of medicine from its earliest beginnings to the accomplishments of today. To condense this immense field within the compass of a small volume of less than 200 pages required a complete mastery of the subject and a point of vision so high as not to be obstructed by any accidental and ephemeral projection. The beginner—and this book grew out of lectures for senior students—will not be confused by a mass of details. He will learn of trends and tendencies which characterized long periods of time, and he will find all those individual achievements emphasized which exerted a profound influence upon contemporaneous and subsequent generations. The development of medicine is not an isolated phenomenon; it is essentially a part of the history of civilization. The course of medicine, says the author, "is dependent upon, and modified by, plague, famine, war, prosperity, peace, invention, adventure, and discovery. Medicine trails along, a handmaiden of the times, serving with blessed benevolence but usually in no greater degree than the times permit; blossoming as the minds of men are stimulated into both activity and receptivity, and languishing in the shadows of decadence which fall, just once so often, across the world." This constant correlation of medicine and general culture is, to my mind, a particularly attractive feature of the book. No claim is made for original research; but the evaluation of medical men and events is distinctly original, and the whole is clothed in beautiful language which makes reading a pleasure and stimulates further study of the subject outlined. GEORGE GELLHORN.

[1] MEDICINE, AN HISTORICAL OUTLINE. By M. G. Seelig, M.D. Baltimore: Williams and Wilkins Company, 1925.

ONE wonders, after reading this life of Lord Lister,[2] if we as teachers of clinical medicine or surgery are even in the slightest way imbuing our students with the enthusiasm and love for fundamental knowledge which Lister passed on to those under him. How many of us are able to give entire lectures or even sprinkle our clinics with facts gained first hand? Perhaps most clinical teachers are content to emphasize bald statements, unquestioned and at times garnished with a solitary personal experience, which repeated recitals make more weighty.

The entire theme of Lord Lister's professional life was his attitude of scientific scepticism which accepted nothing as granted and which required fundamental facts and principles as sufficient evidence. That attitude requires a broad judicial mind, the lack of which is unfortunately too common a fault. To have both is indeed fortunate but to have the attitude of mind alone would carry one far in scientific medicine.

Perhaps we should not be so concerned over whether this or that school of medicine is graduating highly scientifically trained men or whether we should find a means of increasing the supply of men well versed in the art of general practice. Perhaps we should be concerned with instilling into the medical student the enthusiasm and love for searching out the fundamental facts in point; with making him feel more keenly the responsibility of his patients' welfare. Those characteristics were Lister's.

I suppose the older generation of medical men are acquainted with the salient features in Lister's life and many have lived during the later years of his activities. To them this biography will be a pleasant reminder. I know of no book which can be read with more profit by the younger practitioner. The story of his life and work is a true stimulus and his simplicity of experimentation, fixity of purpose, and confidence in scientific facts can well be emulated.

LOYAL DAVIS.

DRS. A. Valassopoulo and Pavlos Petridis[3] have written a work treating exclusively of amœbic dysentery and its hepatic complications, i.e., abscess. It represents the result of 40 years' observation of dysentery cases treated in the Greek Hospital of Alexandria (Egypt), and the wealth of material forming the basis of this study is hinted at by the fact that no less than 211 autopsies on amœbic dysentery cases were performed in this hospital. Of this number, 60 per cent had single and 40 per cent multiple hepatic abscesses. In the vast majority of cases the onset of amœbic hepatic abscesses is insidious, with symptoms so vague that an early

[2] LORD LISTER. By Sir Rickman John Godlee, Bt., K.C.V.O., M.S., F.R.C.S., 3d. ed., Oxford at the Clarendon Press, 1924.

[3] LES HÉPATITES DYSENTÉRIQUES ET LEUR TRAITEMENT. By A. Valassopoulo and Pavlos Petridis. Paris. Masson et Cie, 1924.

diagnosis presents great difficulties. The diagnostic value of the roentgen ray is emphasized. Since the discovery and use of emetine, the number of amœbic abscesses has markedly decreased (90 per cent). Exploratory puncture of the liver is not recommended; it often misses the abscess and may cause profuse hæmorrhage. The surgical treatment of hepatic abscess advocated by Petridis consists in making a transpleural diaphragmotomy, suturing the edges of the cut diaphragm to the subcutaneous tissues, manual exploration of the entire liver, and drainage of all abscesses encountered.

GEORGE DE TARNOWSKY.

A CAREFUL survey of the general results of the treatment of fractures would indicate that but little progress has been made in the last decade, especially so if a comparison is made with the progress in other branches of surgery. The mass of fractures is treated by the general practitioner and the results are notoriously poor. The medical student when he is graduated has little concrete knowledge about fractures. The interne, when he leaves the hospital knows but little more. There is a common belief among surgeons that the general treatment of fractures today is little if any better than it was 20 years ago, some even venturing to say that it is not as good. There is no question but that since the time Lane propounded his open operation technique, less attention has been devoted by the practitioner and surgeon to a close scientific study of the mechanism of fracture and its resultant deformity. The attitude often assumed is, if the fracture cannot be easily reduced and retained, operate. This has led to many disastrous results and has fostered a certain inefficiency which the older practitioner was free from. Many surgeons have made a very careful study of fractures and in many of the larger hospitals there are special fracture services. In these instances a most careful study of each individual case is made and the results are uniformly excellent.

This wide gap between the fracture specialist who treats comparatively few cases and the general practitioner who treats the many, must be bridged. Wilson and Cochrane[1] in a recent treatise on fractures and dislocations have attempted to bridge this gap and have made a good start in this difficult task. There is perhaps no other branch of clinical medicine which is so extensively applied as anatomy and physiology. This fact the authors have taken cognizance of and have therefore introduced the anatomical and physiological considerations as a preface to each group of fractures and dislocations described. It would have been pleasing to note a closer coordination between the mechanism of production and retention of the deformity, and the various forms of treatment advocated. The lack of application of this principle is the stumbling block in the treatment of fractures. In many treatises on fractures the reader is told that a certain fracture is reduced in a certain way and is immobilized in a certain way but he is not told why. If an explanation is made it is, as a rule, so complex and confusing that he is soon lost in a maze of meaningless words. The all important factor is to see, with the mental eye, the bony deformity and the muscles and ligaments which hold the fragments in deformity. Wilson and Cochrane have endeavored to promote this principle and have wisely used illustrations to clarify vague points. It is the reviewer's impression that these authors have therefore presented to the profession a valuable contribution.

Another contribution to the subject of fractures is by Page and Bristow.[2] These authors make no attempt toward presenting a complete treatise of the subject but offer this manual as a practical guide for the student and practitioner. A considerable portion of the manual is devoted to the general principles of fractures. These principles are clearly and concisely stated. The treatment of specific fractures is given in a rather dogmatic way, because the authors are attempting in one small volume, a compilation of essential data, as a handy reference for the practitioner. The value of such a work is questionable, because it advocates the use of physical rule to the exclusion of mental vision. This may be applicable to a certain few cases, but is not conducive to an improvement in the general treatment of fractures.

J. A. WOLFER.

In regard to the Life of General W. C. Gorgas, which was reviewed in the March issue 1925, page 445, we wish to advise that a special edition has been printed for medical men. This edition is being distributed by Messrs. Lea & Febiger of Philadelphia.

[1] FRACTURES AND DISLOCATIONS. By Philip D. Wilson, A.B., M.D., F.A.C.S., and William A. Cochrane, M.B., Ch.B., F.R.C.S. (Edin.). Philadelphia and London: J. B. Lippincott Co., 1925.

[2] THE TREATMENT OF FRACTURES IN GENERAL PRACTICE. By C. Max Page, D.S.O., M.S. (Lond.), F.R.C.S., and W. Rowley Bristow, M.B., B.S. (Lond.), F.R.C.S. London: Henry Frowde, and Hodder & Stoughton.

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PRELIMINARY CLINICAL PROGRAM FOR PHILADELPHIA MEETING

IN the following pages will be found a preliminary program of the clinics and demonstrations to be given in the hospitals and medical schools of Philadelphia during the fifteenth annual session of the Clinical Congress of the American College of Surgeons in Philadelphia, October 26 to 30. The program as published is merely an outline of the program which the Committee on Arrangements is preparing. Under the supervision of the Committee, the program will be revised and greatly amplified during the months preceding the meeting, so that the final program will completely represent Philadelphia's clinical activities in all departments of surgery. A series of clinical demonstrations on "dry clinics" at the larger hospitals, in which surgeons, internists, roentgenologists, pathologists, and other specialists will participate to discuss some of the more important surgical subjects, will form an important feature of the program.

Specialists in ophthalmology, otology, rhinology, and laryngology will find much of interest in a series of clinical demonstrations to be given each forenoon in the Ballroom of the Bellevue-Stratford, arranged to supplement the clinical work in the hospitals in the afternoon, thus providing a full program for each of the four days of the session for those who are particularly interested in these departments of surgery.

General headquarters of the Congress will be established at the Bellevue-Stratford Hotel, Broad and Walnut Streets, where the entire first floor, including the Ballroom, Clover Room, Rose Room, Gold Room, together with the Stratford Room on the main floor and the Rose Garden and other rooms on the roof, have been reserved for the exclusive use of the Congress. These rooms provide ample space for evening meetings, business sessions, hospital standardization headquarters, registration and ticket bureaus, bulletin rooms, etc.

A number of fine large hotels, situated within easy walking distance of the Bellevue-Stratford, have been erected since the last meeting in 1921, so that the hotel situation in Philadelphia has been greatly improved. See list of hotels with their rates on another page.

An application for reduced railway fares on account of the meeting in Philadelphia is pending with the railway passenger associations and it seems assured that a substantial reduction in fares will be granted applying to all sections of the United States and Canada.

EVENING MEETINGS

Monday—Ballroom, 8: Presidential meeting, inaugural address by Dr. Rudolph Matas of New Orleans; John B. Murphy Oration in Surgery.

Tuesday—Ballroom, 8: Scientific papers and discussions, general surgery, etc. Rose Garden, 8: Scientific papers, section on surgery of the eye, ear, nose, and throat.

Wednesday—Ballroom, 8: Scientific papers and discussions, general surgery, etc. Rose Garden, 8: Scientific papers, section on surgery of the eye, ear, nose, and throat.

Thursday—Ballroom, 8: Scientific papers and discussions, general surgery, etc. Rose Garden, 8: Scientific papers, section on surgery of the eye, ear, nose, and throat.

Friday—Ballroom, 8: Thirteenth convocation of the American College of Surgeons; Fellowship Address.

HOSPITAL CONFERENCE

A most interesting and instructive program is being arranged for the first two days of the Clinical Congress at the Bellevue-Stratford. This program will consist of addresses, papers and discussions dealing with the various aspects of hospital standardization such as organization, facilities, personnel, procedures, end-results, and will be of particular interest throughout to hospital trustees, executives and personnel generally, as well as physicians, surgeons, and specialists. Considerable time will be devoted to the discussion of minimum standards for various clinical services and departments in hospitals. The subjects to be discussed have been selected after a careful survey made recently of the hospital field. On the morning of the first day the report of the survey for 1925 will be presented by Dr. Franklin H. Martin, Director General, and Dr. Malcolm T. MacEachern, Director of Hospital Activities.

Numerous national and international associations have been invited to contribute to this program, such as the American College of Physicians, the American Hospital Association, the American, Catholic, Protestant and Methodist Hospital associations, the American Society of Clinical Pathologists, the American Roentgen Ray Society.

A general invitation is extended to hospital trustees, hospital personnel, members of medical staffs and the medical profession generally to attend all sessions of the conference.

A hospital information and service bureau will be maintained throughout the Congress to give assistance to any hospitals having problems which they wish solved.

LIMITED ATTENDANCE

Attendance at the Philadelphia session will be limited to a number that can be comfortably accommodated at the clinics, the limit of attendance being based upon the result of a survey of the amphitheaters, operating rooms, and laboratories in the hospitals and medical schools as to their capacity for accommodating visitors. This plan necessitates registration in advance on the part of all who wish to attend. When the limit of attendance has been reached through advanced registration, no further applications can be accepted.

Attendance at clinics and demonstrations will be controlled by means of special clinic tickets, which plan has proved an efficient means in the past for providing for the distribution of visiting surgeons among the several clinics and insures against overcrowding, as the number of tickets issued for any clinic is limited to the capacity of the room in which that clinic is given.

REGISTRATION FEE

A registration fee of $5.00 is required of each surgeon attending the annual clinical meeting, such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued, which receipt is to be exchanged for a general admission card upon his registration at headquarters during the meeting. This card, which is nontransferable, must be presented to secure clinic tickets and admission to the evening meeting.

ORAL AND PLASTIC SURGEONS

The American Association of Oral and Plastic Surgeons meets on Monday and Tuesday at the Bellevue-Stratford. A number of excellent papers by men of outstanding reputation will be presented at the morning sessions, while special clinics are to be arranged for the afternoons. Dr. Fulton Risdon of Toronto is President and Dr. Leroy M. S. Miner of Boston is Secretary.

GENERAL SURGERY, GYNECOLOGY, OBSTETRICS, ORTHOPEDICS, UROLOGY

UNIVERSITY HOSPITAL

Tuesday

JOHN G. CLARK, C. C. NORRIS, and F. E. KEENE—9. Gynecology.
C. H. FRAZIER, F. GRANT, and TEMPLE FAY—9. Neurosurgery.
B. C. HIRST, E. B. PIPER, J. C. HIRST, II, J. K. JAFFE, G. V. JANVIER, and W. BENSON HARER—9. Obstetrics and gynecology.
GEORGE P. MULLER and I. S. RAVDIN—9. General surgery.
A. BRUCE GILL—9. Orthopedics.
CHEVALIER JACKSON and GABRIEL TUCKER—3. Bronchoscopy.

Wednesday

JOHN G. CLARK, C. C. NORRIS and F. E. KEENE—9. Gynecology.
E. L. ELIASON and DRURY HINTON—9. General surgery.
A. RANDALL, S. W. MOORHEAD, P. S. PELOUZE, and MAURICE MUSCHAT—2. Urology.

Thursday

JOHN G. CLARK, C. C. NORRIS and F. E. KEENE—9. Gynecology.
C. H. FRAZIER, F. GRANT and TEMPLE FAY—9. Neurosurgery.
B. C. HIRST, E. B. PIPER, J. C. HIRST, II, J. K. JAFFE, G. V. JANVIER, and W. B. HARER—9. Obstetrics and gynecology.
G. P. MULLER and I. S. RAVDIN—9. General surgery.
A. BRUCE GILL—9. Orthopedics.
CHEVALIER JACKSON and GABRIEL TUCKER—3. Bronchoscopy.

Friday

JOHN G. CLARK, C. C. NORRIS and F. E. KEENE—9. Gynecology.
C. H. FRAZIER, F. GRANT and TEMPLE FAY—9. Neurosurgery.
B. C. HIRST, E. B. PIPER, J. C. HIRST, II, J. K. JAFFE, G. V. JANVIER, and W. B. HARER—9. Gynecology and obstetrics.
E. L. ELIASON and DRURY HINTON—9. General surgery.
A. BRUCE GILL—9. Orthopedics.

METHODIST EPISCOPAL HOSPITAL

Tuesday

JAMES H. BALDWIN—9. General surgery.

Wednesday

WILLIAM NICHOLSON—9. Gynecology.
L. J. HAMMOND—2. General surgery.
M. F. PERCIVAL—4. Demonstration of X-ray apparatus, radio knife.

Thursday

D. B. PFEIFFER—9. General surgery.
R. O. NORRIS—2. Gynecology.

Friday

J. T. RUGH—9. Orthopedics.
LEON HERMAN—2. Genito-urinary clinic.

JEFFERSON HOSPITAL

Tuesday

J. TORRANCE RUGH—9:30. Orthopedics.
CHARLES F. NASSAU—11. General surgery.
THOMAS C. STELWAGEN—11. Genito-urinary surgery.
JOHN H. GIBBON—2. General surgery.

Wednesday

CHEVALIER JACKSON—9. Bronchoscopy for diagnosis and treatment of diseases of the lungs.
BROOKE M. ANSPACH and staff—9. Gynecology.
P. BROOKE BLAND—9. Gynecology.
W. H. KINNEY—11. Genito-urinary surgery.
JOHN B. FLICK—11. General surgery.
J. CHALMERS DACOSTA—2. Surgical clinic.

Thursday

H. R. LOUX—9. Genito-urinary surgery.
J. M. FISHER—11. Gynecology.
THOMAS A. SHALLOW—11. General surgery.
ARTHUR DAVIDSON—11. Orthopedic surgery.
CHEVALIER JACKSON, GABRIEL TUCKER and LOUIS CLERF—12:30. Bronchoscopic aspiration in suppurative diseases of the lung.

Friday

EDWARD J. KLOPP—11. General surgery.

PENNSYLVANIA HOSPITAL

Tuesday

CHARLES F. MITCHELL, W. ESTELL LEE, HENRY P. BROWN, and LEON HERMAN—11. General surgery.

Wednesday

JOHN H. GIBBON, ARTHUR E. BILLINGS, EDWARD J. KLOPP, JOHN B. FLICK, and LEON HERMAN—11. General surgery.

Thursday

JAMES CAMERON—9. Oral surgery.
J. R. PAUL—10. Surgical pathology.
CHARLES F. MITCHELL, W. ESTELL LEE, HENRY P. BROWN, and LEON HERMAN—11. General surgery.

MT. SINAI HOSPITAL

Tuesday

CHARLES F. NASSAU—9. General surgery.
G. ROSENBAUM—12. Roentgenology.

Wednesday

M. BEHREND—9. General surgery.
M. COOPERMAN—2. Orthopedics.
G. TUCKER—4. Bronchoscopy.

Thursday

J. C. HIRST—9. Gynecology.
G. ROSENBAUM—12. Roentgenology.
G. TUCKER—4. Bronchoscopy.

Friday

C. MAZER—9. Gynecology.
C. HIRSCH—11:30. Urology.

PHILADELPHIA GENERAL HOSPITAL

Tuesday

FRANK C. HAMMOND—10. Gynecology.
WILLIAM H. MACKINNEY—2. Genito-urinary surgery.

Wednesday

A. C. WOOD—9. General surgery.
J. T. RUGH—11. Orthopedic surgery.
J. B. CARNETT, HENRY K. PANCOAST, C. C. NORRIS, F. O. LEWIS, J. F. SCHAMBERG, ROBERT G. TORREY, and GEORGE M. DORRANCE—2. Clinical conference, cancer.

Thursday

J. B. CARNETT—9. Cancer clinic.
EDWARD A. SCHUMANN—2. Gynecology.

Friday

T. T. THOMAS—9. General surgery.
EDWARD B. KRUMBHAAR and pathologists—4. Surgical pathological conference.

EPISCOPAL HOSPITAL

Tuesday

RALPH S. BROMER—9. X-ray demonstration.
LOUIS H. MUTSCHLER—11. Operative clinic.

Wednesday

ASTLEY P. C. ASHHURST—9. Operative clinic.
A. BRUCE GILL—2. Orthopedics.

Thursday

E. G. ALEXANDER—9. Operative clinic.
H. C. DEAVER—11. Operative clinic.

Friday

E. T. CROSSAN—9. Demonstration in surgical pathology.
L. H. MUTSCHLER—11. Operative clinic.

PRESBYTERIAN HOSPITAL

J. H. JOPSON, JOHN SPEESE, D. B. PFEIFFER, J. S. RODMAN, and HENRY P. BROWN, JR. General surgery.
JOHN H. GIRVIN, GEORGE M. LAWS and PHILIP WILLIAMS. Gynecology.
B. A. THOMAS and staff. Genito-urinary surgery.
A. BRUCE GILL and T. E. ORR. Orthopedic surgery.
FRANK CROZER KNOWLES and HENRY G. MUNSON. Dermatology.
JOHN A. EIMAN and W. EDGAR CHRISTIE; JOHN H. GIRVIN and staff; B. A. THOMAS and F. G. HARRISON. Surgical and special pathology.
WILLIAM S. NEWCOMET. Roentgenology.
Operative clinics daily at 9. Demonstrations and pathological exhibits in new out-patient and laboratory building at 2:30.

WOMEN'S HOMEOPATHIC HOSPITAL

Tuesday

JOHN A. BROOKE—2. Orthopedics.

Wednesday

ARTHUR HARTLEY—2. General surgery.

Friday

FRANCOIS L. HUGHES—10. Gynecology.

MISERICORDIA HOSPITAL

Tuesday

BASIL BELTRAN and staff—9. General surgery.
JAMES A. KELLY and staff—9. General surgery.

Wednesday

GEORGE P. MULLER and THOMAS RYAN—9. General surgery.
PETER M. KEATING—9. Clinical demonstration.
J. F. X. JONES—2. General surgery.

Thursday

BASIL BELTRAN and staff—9. General surgery.
JAMES A. KELLY and staff—9. General surgery.

Friday

GEORGE P. MULLER and THOMAS RYAN—9. General surgery.
PETER M. KEATING—9. Clinical demonstration.
J. F. X. JONES—2. General surgery.

POLYCLINIC HOSPITAL

Tuesday

DEFOREST P. WILLARD—10:30. Orthopedics.
G. E. PFAHLER—2. Radiologic conference.
B. A. THOMAS—2. Urology.

Wednesday

R. H. IVY and LAWRENCE CURTIS—10. Oral surgery.
W. G. ELMER—11:30. Orthopedic surgery.

Thursday

COLLIER F. MARTIN—1. Proctology.
J. F. SCHAMBERG—2. Arsphenamin clinic.

Friday

R. H. IVY—9. Maxillo-facial surgery.
B. A. THOMAS—2. Urology.
E. A. CASE—2. Surgical pathology.

HAHNEMANN HOSPITAL

Tuesday

L. T. ASHCRAFT—9. Genito-urinary clinic.
D. B. JAMES and staff—9. Gynecology.
J. E. JAMES and LEON CLEMMER—10. Obstetrical operations.
F. W. SMITH—2. Bronchoscopy.
F. C. BENSON, JR.—3. Radium clinic.

Wednesday

H. L. NORTHROP—9. General surgery.
D. B. JAMES and staff—9. Gynecology.
W. C. MERCER and J. B. BERT—10. Labor, its mechanism.
S. W. SAPPINGTON—3. Demonstration of transfusion methods.

Thursday

D. B. JAMES and staff—9. Gynecology.
J. D. ELLIOTT and J. A. BROOKE—9. General surgery.
O. B. WAITE and N. F. PAXON—10. Prenatal clinic.
J. W. FRANK—3. Roentgenologic clinic.

Friday

G. A. VAN LENNEP and H. P. LEOPOLD—9. General surgery.
D. B. JAMES and staff—9. Gynecology.

CHILDREN'S HOSPITAL

Tuesday

J. H. JOPSON—9. Diagnosis in surgical diseases of the abdomen.
J. C. GITTINGS—9. Some medical aspects of surgical cases.
C. W. BURR and F. E. LEAVITT—9. Neuro-surgical problems in children.
C. C. NORRIS—2. Vaginitis in infants and young children; methods of treatment.

Wednesday

W. ESTELL LEE and J. R. WELLS—9. Problems in thoracic surgery. Treatment of burns.
R. S. BROMER—9. X-ray in thoracic and gastro-intestinal lesions.

Thursday

HOWARD C. CARPENTER—9. Health examination in children.
EMILY P. BACON—9. Demonstration of nutritional work in children.
SUSAN C. FRANCIS, R. N.—9. Problems in management of surgical wards.

Friday

JOHN SPEESE and W. EDGAR CHRISTIE—9. Postoperative management of surgical cases.
HENRY P. BROWN and Ernest G. WILLIAMSON—9. Management of the surgical out-patient department.

COOPER HOSPITAL (Camden)

Tuesday

THOMAS B. LEE, ALBERT B. DAVIS and GORDON WEST—9. Gynecology.

Wednesday

PAUL M. MECRAY and associates—10. General surgery.
A. HAINES LIPPINCOTT and DAVID BENTLEY JR.—2:30. Genito-urinary and rectal clinic.
B. F. BUZBY—2:30. Orthopedic clinic.

Thursday

THOMAS B. LEE, ALBERT B. DAVIS and GORDON WEST—9. Gynecology.

Friday

PAUL M. MECRAY and associates—10. General surgery.
B. F. BUZBY—2:30. Orthopedics.

ST. LUKE'S HOSPITAL

Tuesday

DESIDERIO ROMAN—9. General surgery.
O. F. BARTHMAIER—11. Demonstration of blood transfusion.

Wednesday

A. B. WEBSTER—9. General surgery.
J. WALTER POST—11. Demonstration in roentgenology.

Thursday

DESIDERIO ROMAN—9. Operations upon thyroid and demonstration of group study of thyroid disease.

Friday

A. B. WEBSTER—9. General surgery.
J. WALTER POST—11. Demonstration in roentgenology.

WOMAN'S HOSPITAL

Tuesday

SARAH H. LOCKREY and EMILY WHITTEN-AUGE—9. Gynecology.
LIDA STEWART-COGILL and ELIZABETH HUGHES—2. Obstetrics.
JULIA HARDIN. Gas-oxygen and ethylene anæsthesia.

Wednesday

MARIE K. FORMAD and ALBERTA PELTZ—9. Gynecology.
ELLA WILLIAMS GRIM and ALBERTA PELTZ—3. Obstetrics.
JULIA HARDIN. Gas-oxygen and ethylene anæsthesia.

Thursday

CATHARINE MACFARLANE and FAITH S. FETTERMAN—9. Gynecology.
MARY LEWIS and DELLA MILDAZIAS—3. Obstetrics.
JULIA HARDIN. Gas-oxygen and ethylene anæsthesia.

Friday

KATE W. BALDWIN—9. General surgery.
ELIZABETH F. C. CLARK—11. Gynecology.
ANN TOMKINS GIBSON and JESSIE W. PRYOR—2. Obstetrics.
EMILY WHITTEN-AUGE—3. General surgery.
JULIA HARDIN. Gas-oxygen and ethylene anæsthesia.

ORTHOPEDIC HOSPITAL

Tuesday

ASTLEY P. C. ASHHURST, JOHN CROSSAN and B. F. BUZBY—1. Orthopedic demonstration.

Thursday

ASTLEY P. C. ASHHURST, JOHN CROSSAN and B. F. BUZBY.—9. Orthopedic operations.

Friday

A. BRUCE GILL, C. R. BOWEN and JAMES E. WYANT. Orthopedic clinic.

CHESTNUT HILL HOSPITAL

Tuesday

ANDREW GODFREY and WILLIAM SHEEHAN—10. General surgery.
ALEXANDER RANDALL—2. Urology.

Wednesday

J. MURRAY ELLZEY—10. Fracture clinic.

Thursday

J. F. MCCLOSKEY—10. General surgery.

WOMAN'S COLLEGE HOSPITAL

Tuesday

LIDA STEWART COGILL—9. Prenatal clinic.

Wednesday

J. S. RODMAN and staff—9. General surgery.

Thursday

CATHARINE MACFARLANE—2. Gynecology.

Friday

J. S. RODMAN and staff—9. General surgery.

LANKENAU HOSPITAL

Tuesday

STANLEY P. REIMAN—9. Demonstrations in new laboratory.
A. G. MILLER, and ROBERT SHOEMAKER—11. Demonstration in roentgenology.
F. L. HARTMAN—11. Demonstration of follow-up system.

Wednesday

STANLEY P. REIMAN—9. Demonstration in new laboratory.
F. L. HARTMAN—11. Demonstration of follow-up system.
A. G. MILLER and ROBERT SHOEMAKER—11. Demonstration in roentgenology.
JOHN B. DEAVER—12. General surgery.

Thursday

F. L. HARTMAN—11. Demonstration of follow-up system.
A. G. MILLER and ROBERT SHOEMAKER—11. Demonstration in roentgenology.
JOHN B. DEAVER—12. General surgery.
WILLIAM H. MACKINNEY—3:30. Cystoscopy.

Friday

STANLEY P. REIMAN—9. Demonstration in new laboratory.
A. G. MILLER and ROBERT SHOEMAKER—11. Demonstration in roentgenology.
F. L. HARTMAN—11. Demonstration of follow-up system.

MEDICO-CHIRURGICAL HOSPITAL

Tuesday

J. B. CARNETT—9. General surgery.
GEORGE M. BOYD—11. Gynecology.

Wednesday

GEORGE W. OUTERBRIDGE—9. Cystoscopy.
WILLIAM R. NICHOLSON—9. Gynecology.

Friday

J. B. CARNETT—9. General surgery.
GEORGE M. BOYD—11. Gynecology.

ST. AGNES HOSPITAL

Tuesday

E. C. MURPHY and J. F. X. JONES—9. General surgery.
JOHN A. MCGLINN—9. Gynecology.

Wednesday

G. M. DORRANCE and J. W. BRANSFIELD—9. General surgery.
JOHN M. FISHER—9. Gynecology.
WILBUR B. HAINES—2. Genito-urinary surgery.
J. C. HIRST and staff—2. Gynecology and obstetrics.

FRANKFORD HOSPITAL

Wednesday

W. E. PARKE, E. A. SCHUMANN, G. C. HANNA, and F. E. KELLER—9:30. Gynecology.

Thursday

CHARLES F. NASSAU and LOUIS D. ENGLERTH—9:30. General surgery.

SAMARITAN HOSPITAL

Tuesday

JOHN LEEDOM, J. O. BOWER, G. MASON ASTLEY, JOHN C. FRICK, and J. N. COOMBS—9. Surgical clinic.
HARRY HUDSON—2. Orthopedic clinic.
ALBERT STRICKLER—3. Dermatology.

Wednesday

W. WAYNE BABCOCK—9. General surgery.
CHARLES S. BARNES and C. M. STIMSON—11. Obstetrics.
FRANK C. HAMMOND—2. Gynecology.
W. HERSHEY THOMAS—4. Genito-urinary surgery.
HARRY Z. HIBSHMAN—5. Rectal clinic.

Thursday

A. C. APPLEGATE—11. Obstetrics.

Friday

W. WAYNE BABCOCK—9. General surgery.

HOWARD HOSPITAL

Tuesday

A. C. WOOD—9. General surgery.
E. L. ELIASON—10. General surgery.

Wednesday

B. C. HIRST—9. Gynecology.

Thursday

A. C. WOOD—9. General surgery.
E. L. ELIASON—10:30. General surgery.
S. W. MOORHEAD—4. Genito-urinary surgery.

Friday

B. C. HIRST—9. Gynecology.

ST. JOSEPH'S HOSPITAL

Tuesday

JOSEPH M. SPELLISSY—9. Orthopedics.
JOHN F. X. JONES—10:30. General surgery.

Wednesday

MELVIN M. FRANKLIN—9. General surgery.
F. HURST MAIER—11. Gynecology.

Thursday

JAMES A. KELLY—9. General surgery.

Friday

CHARLES F. NASSAU—9. General surgery.
P. BROOKE BLAND—11. Gynecology.

JEWISH HOSPITAL

Tuesday

W. H. TELLER—9. General surgery.

Wednesday

F. B. BLOCK—9. General surgery.

Thursday

M. BEHREND—9. General surgery.

Friday

L. BRINKMAN—9. General surgery.

KENSINGTON HOSPITAL FOR WOMEN

Tuesday

WILLIAM E. PARKE—11. Prenatal clinic.
H. C. DEAVER—12:30. Gynecology.

Friday

WILLIAM E. PARKE—11. Prenatal clinic.

NORTHEASTERN HOSPITAL

Wednesday

H. Z. HIRSHMAN—9. Proctology.
T. TURNER THOMAS—10. General surgery.
JOHN B. LOWNES and J. A. BROADFIELD—3. Urology.

Thursday

T. TURNER THOMAS—2. General surgery.

CHILDREN'S HOMEOPATHIC HOSPITAL

Wednesday

JOHN BROOKE—2. Orthopedics.

Thursday

A. KARNDOERFER, JR.—2. Gynecology.

Friday

H. P. LEOPOLD—10. General surgery.

ST. CHRISTOPHER'S HOSPITAL

Tuesday

E. G. ALEXANDER—10. Surgery in children.

STETSON HOSPITAL

Tuesday

JOHN A. BOGER and WILLIAM T. ELLIS—1. General surgery.

Wednesday

S. E. TRACY and ASSOCIATES—9. Gynecology.

Thursday

BROOKE M. ANSPACH and ASSOCIATES—9. Gynecology.

Friday

S. E. TRACY and ASSOCIATES—9. Gynecology.
CARL F. KOENIG—1. Roentgenology.

NORTHWESTERN GENERAL HOSPITAL

Tuesday

J. O. ARNOLD. Obstetrics.

Wednesday

J. THOMPSON SCHELL. General surgery.

Thursday

ARTHUR D. KURTZ. Orthopedics.

Friday

ROBERT BOYER. Genito-urinary.

AMERICAN ONCOLOGIC HOSPITAL

Tuesday

W. S. NEWCOMET—10. Cases of angioma, treated and under treatment, selected from a group of 200.
SAMUEL MCCLARY, 3rd. Cases of cancer of the lip and mouth.

SURGERY OF THE EYE, EAR, NOSE, AND THROAT

CLINICAL DEMONSTRATIONS

In the Ballroom, Bellevue-Stratford

Tuesday—9 A.M.

J. PARSON SCHAEFFER, Philadelphia: Otolaryngology.
G. E. DESCHWEINITZ, Philadelphia: Ophthalmology.
JOSEPH C. BECK, Chicago: Otolaryngology.
WELLS P. EAGLETON, Newark, N. J.: Otology.

Wednesday—9 A.M.

CHEVALIER JACKSON, Philadelphia: Chalk talk.
DOUGLAS QUICK, New York: Radium and X-ray in the treatment of malignant disease of the paranasal sinuses.
JOHN E. MACKENTY, New York, FIELDING O. LEWIS, Philadelphia: Total laryngectomy.

Thursday—9 A.M.

H. P. MOSHER, Boston: Otolaryngology.
EDWARD B. DENCH, New York: Otology.
C. M. SAUTTER, New York: Otolaryngology.

CHESTNUT HILL HOSPITAL

Wednesday

BENJAMIN PARISH and JOHN DAVIES—2. Otolaryngology.

Thursday

CARL WILLIAMS—2. Ophthalmology.

WILLS EYE HOSPITAL

Tuesday

BURTON CHANCE, FRANK C. PARKER, LEIGHTON F. APPLEMAN and BENJAMIN F. BAER, JR.—2. Ophthalmic operations.

Wednesday

WILLIAM ZENTMAYER, PAUL J. PONTIUS, J. MILTON GRISCOM, and THOMAS A. O'BRIEN—2. Ophthalmic operations.

Thursday

BURTON CHANCE, FRANK C. PARKER, LEIGHTON F. APPLEMAN, and BENJAMIN F. BAER, JR.—2. Ophthalmic operations.

Friday

WILLIAM ZENTMAYER, PAUL J. PONTIUS, J. MILTON GRISCOM and THOMAS A. O'BRIEN—2. Ophthalmic operations.

MT. SINAI HOSPITAL

Tuesday

L. FISHER—2. Otolaryngology.
C. W. LEFEVER—4. Ophthalmology.

Thursday

S. J. GITTELSON—2. Ophthalmology.

Friday

A. W. WATSON—2. Laryngology.

EPISCOPAL HOSPITAL

Tuesday

W. R. WATSON—2. Otolaryngology.
HAROLD G. GOLDBERG–2. Ophthalmology.

Wednesday

A. G. FEWELL—2. Ophthalmology.
W. R. WATSON—2. Otolaryngology.

Thursday

FREDERICK KRAUSS—2. Ophthalmology.
CHARLES C. BIEDERT—2. Otolaryngology.

Friday

CHARLES C. BIEDERT—2. Otolaryngology.
HAROLD G. GOLDBERG—2. Ophthalmology.

CHILDREN'S HOSPITAL

Wednesday

H. MAXWELL LANGDON and A. R. RENNINGER—2. Ophthalmology.

Thursday

JAMES A. BABBITT and staff—2. Otolaryngology.

COOPER HOSPITAL (Camden)

Tuesday

L. B. HIRST, E. R. HIRST and ALFRED ELWELL—2:30. Otolaryngology.

Thursday

L. B. HIRST, E. R. HIRST and ALFRED ELWELL—2:30. Otolaryngology.

WOMAN'S HOSPITAL

Tuesday

LAURA E. HUNT and MARY HIPPLE—2. Otolaryngology.

Wednesday

MARGARET A. WARLOW—1:30. Otolaryngology.
MARY BUCHANAN—2. Ophthalmology.

Thursday

MARGARET F. BUTLER and LOUIS VAN LOON—2. Otolaryngology.

MISERICORDIA HOSPITAL

Tuesday

JOHN E. LOFTUS—2. Otolaryngology.

Wednesday

C. T. MCCARTHY—2. Otolaryngology.
HAROLD GOLDBERG—3. Ophthalmology.

Thursday

JOHN E. LOFTUS—2. Otolaryngology.
JOHN A. COLGAN—3. Ophthalmology.

Friday

C. T. MCCARTHY—2. Otolaryngology.

WOMEN'S HOMEOPATHIC HOSPITAL

JOSEPH F. V. CLAY—Thursday, 2. Otolaryngology.

JEFFERSON HOSPITAL

Thursday

FIELDING O. LEWIS—2. Otolaryngology.

Friday

HOWARD F. HANSELL and WILLIAM M. SWEET—2. Ophthalmology.
S. MACCUEN SMITH and J. CLARENCE KEELER—2. Otology.

HOWARD HOSPITAL

Tuesday

G. B. WOOD—2. Laryngology.

Wednesday

W. C. POSEY—2. Ophthalmology.

Thursday

G. B. WOOD—2. Laryngology.

Friday

W. C. POSEY—2. Ophthalmology.

POLYCLINIC HOSPITAL

Tuesday

T. B. HOLLOWAY—2. Ophthalmology.

Wednesday

WALTER ROBERTS—2. Otolaryngology.
E. B. GLEASON—3. Otolaryngology.
L. C. PETER—3. Ophthalmology.

Thursday

GEORGE B. WOOD—3. Laryngology.
RALPH BUTLER—3. Laryngology.

ST. AGNES HOSPITAL

Tuesday

BENJAMIN D. PARISH—2. Otolaryngology.

Wednesday

WARREN B. DAVIS—2. Otolaryngology.
G. F. J. KELLY—2. Ophthalmology.

HAHNEMANN HOSPITAL

Wednesday

G. F. PALEN—2. Otology.

Thursday

H. S. WEAVER and C. B. HOLLIS—2. Laryngology.

Friday

F. O. NAGLE—2. Ophthalmology.

PHILADELPHIA GENERAL HOSPITAL

DAVID N. HUSIK—Friday, 2. Otolaryngology.

SAMARITAN HOSPITAL

LUTHER C. PETER—Tuesday, 4. Ophthalmology.

UNIVERSITY HOSPITAL

Tuesday

THOMAS B. HOLLOWAY—2. Ophthalmology.
G. FETTEROLF, J. A. BABBITT, D. HUSIK, and LEWIS FISHER—3. Otolaryngology.

Wednesday

G. FETTEROLF, J. A. BABBITT, D. HUSIK, and L. FISHER—3. Otolaryngology.

Thursday

THOMAS B. HOLLOWAY—2. Ophthalmology.

Friday

THOMAS B. HOLLOWAY—2. Ophthalmology.
GEORGE FETTEROLF, J. A. BABBITT, DAVID HUSIK, and LEWIS FISHER—3. Otolaryngology.

WOMAN'S COLLEGE HOSPITAL

Tuesday

MARGARET F. BUTLER—2. Otolaryngology.

Friday

MARY BUCHANAN—3. Ophthalmology.

METHODIST EPISCOPAL HOSPITAL

Tuesday

WALTER ROBERTS—2. Otolaryngology.
PHILIP MOORE—4. Ophthalmology.

FRANKFORD HOSPITAL

FRANK EMBERY and W. J. WATSON—Tuesday, 9:30. Otolaryngology.

CHILDREN'S HOMEOPATHIC HOSPITAL

FRED W. SMITH—Tuesday, 2. Laryngology.

STETSON HOSPITAL

CARLE L. FELT and ASSOCIATES—Wednesday, 1. Otolaryngology.

MEDICO-CHIRURGICAL HOSPITAL

Tuesday

GEORGE M. COATES—2. Otolaryngology.

Wednesday

ROSS H. SKILLERN—2. Laryngology.

Thursday

GEORGE M. COATES—2. Otolaryngology.

Friday

ROSS H. SKILLERN—2. Laryngology.

ST. JOSEPH'S HOSPITAL

Tuesday

GEORGE M. MARSHALL—2. Otolaryngology.
PAUL J. PONTIUS—2. Ophthalmology.

Wednesday

CHARLES J. JONES—2. Ophthalmology.
WILLIAM E. QUICKSALL—2. Otolaryngology.

Thursday

ARTHUR WRIGLEY—2. Otolaryngology.
THOMAS A. O'BRIEN—2. Ophthalmology.

Friday

CORNELIUS T. MCCARTY—2. Otolaryngology.

PRESBYTERIAN HOSPITAL

H. MAXWELL LANGDON and staff. Ophthalmology.
N. P. STAUFFER and Staff. Otolaryngology.

FRANKFORD HOSPITAL

FRANK EMBERY and W. J. WATSON—Tuesday, 9:30. Otolaryngology.

NORTHEASTERN HOSPITAL

Wednesday

GEORGE E. SHAFFER—2. Laryngology.
GRANVILLE A. LAWRENCE—4. Ophthalmology.

JEWISH HOSPITAL

S. MCC. SMITH and A. S. KAUFMAN—Thursday, 3. Otology.

PHILADELPHIA HOTELS AND THEIR RATES

	Minimum Rate for Room with Bath	
	Single	Double
Adelphia, Chestnut and 13th Sts.	$4.00	$8.00
Bellevue-Stratford, Broad and Walnut Sts.	5.00	8.00
Benjamin Franklin, Chestnut at 9th St.	3.00	6.00
Green's, 8th and Chestnut Sts.	3.50	5.00
Longacre, Walnut St. West of Broad.	4.00	6.00
Lorraine, Broad St. at Fairmount Ave.	2.50	5.00
Majestic, Broad St. at Girard Ave.	4.00	5.00
Robert Morris, 17th and Arch and the Parkway	3.00	5.00
Pennsylvania, Chestnut at 39th St.	3.00	6.00
Rittenhouse, Chestnut and 22nd Sts.	3.50	5.00
Ritz-Carlton, Broad and Walnut Sts.	6.00	10.00
St. James, Walnut and 13th Sts.	3.50	5.00
Stenton, Broad and Spruce Sts.	5.00	7.00
Sylvania, Locust and Juniper Sts.	4.00	6.00
Walton, Broad and Locust Sts.	3.00	5.00

STATE AND PROVINCIAL SECTIONAL MEETINGS

ELEVEN Sectional Meetings of the American College of Surgeons have been held since the first of January, as follows:

Oregon, British Columbia, Washington
Portland, Ore., January 26–27
California, Nevada, Arizona
San Diego, Cal., February 2–3
Texas, New Mexico, Old Mexico
El Paso, Texas, February 6–7
Arkansas, Kansas, Oklahoma, Missouri
Little Rock, Ark., February 10–11
Alabama, Mississippi, Louisiana, Georgia, Florida
Mobile, Ala., February 13–14
Kentucky, Tennessee Louisville, Ky., February 16–17
Indiana, Ohio Indianapolis, Ind., February 19–20
South Carolina, North Carolina
Charleston, S. C., March 16–17
West Virginia, Virginia, Maryland, District of Columbia
Charleston, W. Va., March 20–21
Pennsylvania, New Jersey, Delaware
Scranton, Penna., March 23–24
New England States New Haven, Conn., March 26–27

The visiting speakers at these meetings were as follows: George W. Crile, Cleveland, Ohio; Franklin H. Martin, Chicago; Hugh Cabot, Ann Arbor, Michigan; Alfred W. Adson, Rochester, Minnesota; Edward Jackson, Denver, Colorado; William Carpenter MacCarty, Rochester, Minnesota; Vilray Blair, St. Louis, Missouri; J. Garland Sherrill, Louisville, Kentucky; Haven Emerson, New York City; Basil Graves, London, England; Robert Greenough, Boston, Massachusetts; Mr. Robert Jolly, Houston, Texas; Rev. Newton Davis, Chicago; Rev. J. A. Diekmann, Cincinnati, Ohio; Rev. C. B. Moulinier, S. J., Milwaukee, Wisconsin; Malcolm T. MacEachern, Chicago; and Allan Craig, Chicago.

One of the pleasing features of these meetings was the fact that representatives of the American College of Physicians were present at practically every meeting and took part in the program. The attending representatives from the American College of Physicians were as follows: Frank Smithies, Chicago; Frederick Epplen, Spokane, Washington; Frank Pottenger, Monrovia, California; George M. Eckel, Hot Springs, Arkansas; James F. Churchill, San Diego, California; John M. Blackford, Seattle, Washington; Lee W. Roe, Mobile, Alabama; Charles G. Lucas, Louisville, Kentucky; William A. Jenkins, Louisville, Kentucky; Stewart R. Roberts, Atlanta, Georgia; J. N. Simpson, Morgantown, West Virginia; John Lichty, Clifton Springs, New York.

The above group of Sectional Meetings was easily the best the College of Surgeons has conducted. Everywhere there was a large attendance of Fellows of the College and those interested in hospitals. The public meetings far out-reached our fondest expectations. In the city of Portland there was gathered one of the largest audiences which had ever assembled in that city.

The motion picture film entitled, "How the Fires of the Body Are Fed" released by the Pictorial Clubs, Inc., was a decided sensation for both the public and the profession.

Both doctors and laymen were enthusiastic about these sectional meetings. The local committees are to be congratulated upon the splendid results of their work.

THE WASHINGTON MEETING OF THE CLINICAL CONGRESS OF INTERNAL MEDICINE

DOCTOR CHARLES H. MAYO, president of the American College of Surgeons and Dr. Allan Craig, associate director for State and Provincial Activities, were delegated by the Board of Regents, on request, to represent the American College of Surgeons at the Clinical Congress of Internal Medicine and at the meeting of the Board of Regents of the American College of Physicians, held in Washington on March 9. Both Doctors Mayo and Craig gave short addresses at the opening session of the Congress and placed particular emphasis on the importance of co-operation within the medical profession.

At the meeting of the Board of Regents of the American College of Physicians, Dr. Craig outlined three of the outstanding features of the work of the American College of Surgeons—Hospital Standardization, Sectional Meetings, and the Junior Candidate idea. Dr. Mayo enlarged upon these three and urged the co-operation of the American College of Physicians.

Too much could not be said of the splendid reception accorded Doctors Mayo and Craig by both the Congress and the Regents of the College of Physicians. The Regents were unanimous in their desire to co-operate in the activities of the American College of Surgeons.

Two representatives of the College of Physicians are to attend one of the future meetings of the Board of Regents of the American College of Surgeons, and representatives will be present at the coming Sectional Meetings.